FLORA OF SOUTHERN AFRICA

BRYOPHYTA

Editor O. A. Leistner

Part 1 Mosses

Fascicle 1

Sphagnaceae—Grimmiaceae

by Robert E. Magill

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FLORA OF SOUTHERN AFRICA

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FLORA OF SOUTHERN AFRICA

BRYOPHYTA

PART 1, FASCICLE 1

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FLORA OF SOUTHERN AFRICA

which deals with the territories of

SOUTH AFRICA, TRANSKEI, LESOTHO, SWAZILAND, BOPHUTHATSWANA,
SOUTH WEST AFRICA/NAMIBIA, BOTSWANA AND VENDA

BRYOPHYTA

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Fascicle 1 Sphagnaceae — Grimmiaceae

by

Robert E. Magill

Edited by

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Editorial Committee: B. de Winter, D. J. B. Killick and O. A. Leistner

Botanical Research Institute,
Department of Agriculture and Fisheries

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CONTENTS

	Page
New taxa and a new combination published in part 1, fascicle 1	vi
Geographical regions referred to in this fascicle	vii
Introduction	ix
Vegetation formations in the Flora area	ix
Fynbos	ix
Desert/Karoo	x
Grassland/savanna	x
Woodland	x
Forest	x
Alpine heath-grassland	xi
Collecting, preservation, study and identification of the mosses of Southern Africa	xi
Collecting	xi
Preservation	xii
The moss packet	xii
Study and identification	xii
Characters used in keys and descriptions	xiv
Illustrations	xv
Glossary	1
Conspectus of classification	13
Literature cited	15
Provisional key to the families of fascicle 1	17
SPHAGNACEAE	23
ANDREAEACEAE	33
FISSIDENTACEAE	39
NANOBRYACEAE	69
ARCHIDIACEAE (by J. van Rooy)	71
DITRICHACEAE	83
SELIGERIACEAE	103
DICRANACEAE	105
CALYMPERACEAE	161
ENCALYPTACEAE	173
POTTIACEAE	177
BRYOBARTRAMIACEAE	269
GRIMMIACEAE	271
Index to fascicle 1	283

NEW TAXA AND A NEW COMBINATION PUBLISHED IN PART 1 FASCICLE 1

Acaulon recurvatum *Magill,* sp. nov., p. 199

Acaulon rufochaete *Magill*, sp. nov., p. 201

Andreaea bistratosa *Magill,* sp. nov., p. 37

Barbula microcalycina *Magill,* sp. nov., p. 241

Bruchia foveolata *Magill*, sp. nov., p. 108

Chorisodontium falcatum *Magill*, sp. nov., p. 154

Crossidium apiculatum *Magill,* sp. nov., p. 195

Crossidium spiralifolium *Magill,* sp. nov., p. 197

Fissidens capriviensis *Magill,* sp. nov., p. 45

Husnotiella plicata *Magill,* sp. nov., p. 222

Leucoperichaetium *Magill,* gen. nov., p. 271

Leucoperichaetium eremophilum *Magill*, sp. nov., p. 273

Pleuridium papillosum *Magill*, sp. nov., p. 88

Pottia namaquensis *Magill,* sp. nov., p. 206

Weisiopsis involuta *Magill,* sp. nov., p. 225

Desmatodon longipedunculatus (*C. Müll.*) *Magill,* comb. nov., p. 210

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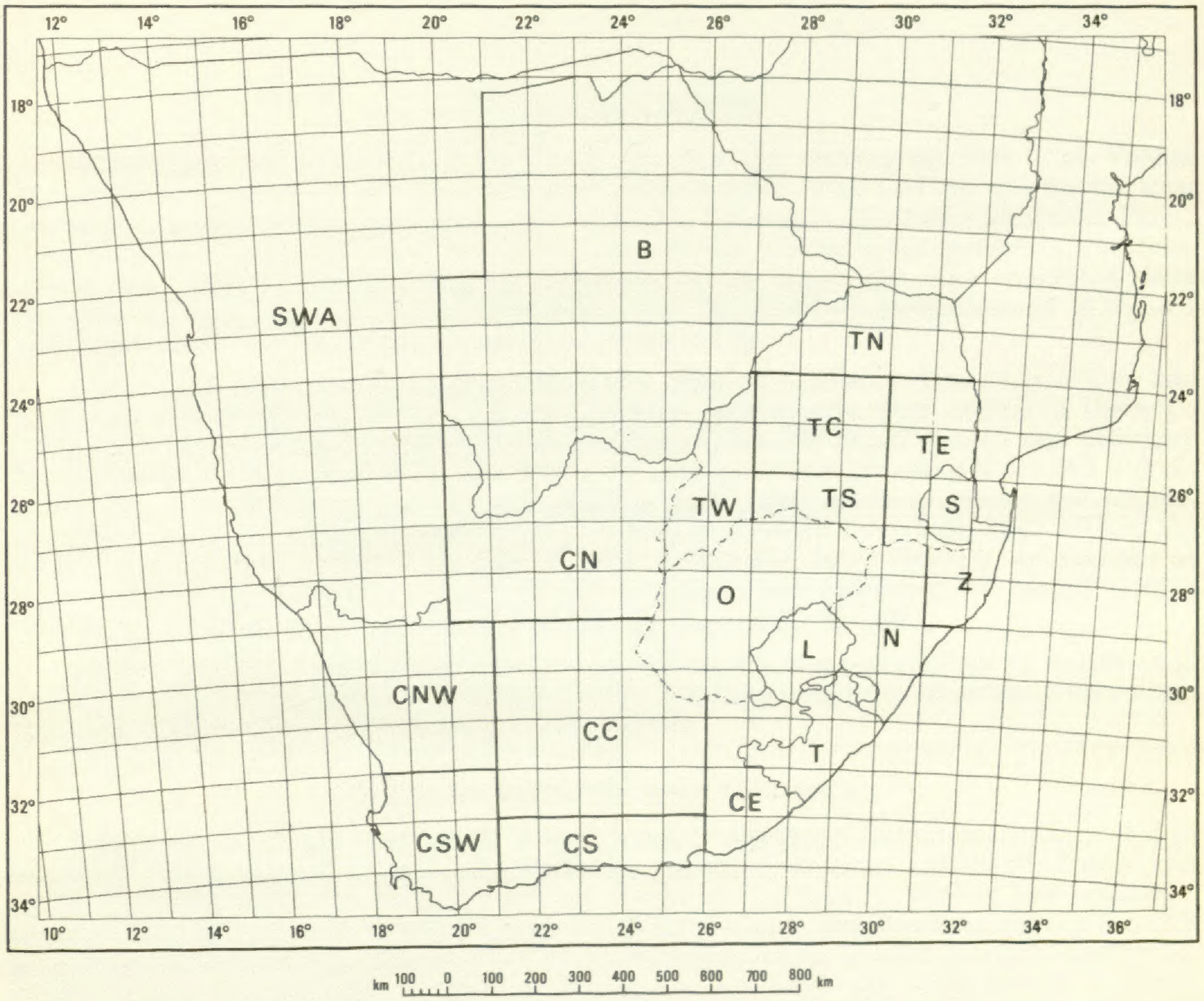


GEOGRAPHICAL REGIONS REFERRED TO IN THIS FASCICLE

B—Botswana

CC—central Cape

CE—eastern Cape

CN—northern Cape

CS—southern Cape

CNW—northwestern Cape

CSW—southwestern Cape

L—Lesotho

N—Natal

O—Orange Free State

S—Swaziland

SWA—South West Africa/Namibia

T—Transkei

TC—central Transvaal

TE—eastern Transvaal

TN—northern Transvaal

TS—southern Transvaal

TW—western Transvaal

Z—Zululand

INTRODUCTION

The following text represents the first of four fascicles making up Part 1 of **Volume Bryophyta** in the Flora of Southern Africa Cryptogam series. Part 1 of this volume will treat the mosses, including Sphagnopsida, Andreaeopsida, Bryopsida and Polytrichopsida, Part 2 being reserved for the Liverworts and Hornworts. Fascicle 1 includes Sphagnopsida, Andreaeopsida and roughly, the Acrocarpi-haplolepideae of the Bryopsida. The remaining three fascicles will treat the Acrocarpi-diplolepideae and Pleurocarpi-diplolepideae of Bryopsida and Polytrichopsida (see Conspectus of classification, p. 13).

The comparatively large temperate bryophyte flora of Southern Africa has a long and interesting bibliographical history. Several Southern African taxa were treated in Hedwig's (1801) *Species Muscorum Frondosorum* and Hooker's (1918–20) *Musci Exotici* and reference has continuously been made to Southern African taxa up to and including Scott and Stone's (1976) *Mosses of Southern Australia* and Smith's (1978) *Moss Flora of Britain and Ireland.* Historical aspects of the bryological activity in Southern Africa have been dealt with in the introduction of Sim's (1926) *Bryophyta of South Africa* and, more recently, an account of Southern African bryological collections and collectors was published by Magill (1980). Further information will soon be made available by Gunn & Codd (1981).

Several excellent texts are available on the life history and morphology of mosses, e.g. Flowers (1973), Parihar (1965) and Watson (1972); therefore only brief accounts of taxonomically important structures will be given in each fascicle.

Vegetation formations in the Flora area

Bryophytes are found within each of the six major vegetation formations encountered in Southern Africa, namely fynbos, desert/karoo, grassland/savanna, woodland, forest and alpine heath-grassland. The Southern African mosses are frequently more or less restricted, at least at the species level, to one of these formations. Many taxa, however, show a broader environmental tolerance and occur in two or more formations, or at least in transitional zones between them. For example, species of *Macrocoma* are frequently collected in savanna, woodland and forest formations (vide Magill & Vitt, 1981). Likewise, *Fabronia* is collected over large areas of Southern Africa dominated by grasslands, savannas or woodlands.

A synopsis of the phytogeographical relationships of the Southern African mosses will only be possible after completion of all four fascicles. A brief statement on each of the vegetation formations is given here as an aid to identification and as a provisional reference to distribution patterns cited in the text.

Fynbos

Restricted primarily to the extreme southern tip of Africa, this vegetation formation contains a unique flora of ericoid and restioid elements, spread across the mountains and coastal lowlands of the southern and western Cape. Fynbos is not difficult to identify in the field, but older collections can frequently only be tentatively placed within the fynbos formation. This is primarily due to the rather discontinuous distribution of this formation, and the remnant patches of forest or of karoo vegetation scattered throughout its area.

In addition it is also frequently difficult to determine whether or not the mosses are truly part of the lowland fynbos. Mosses only rarely grow on the coarse quartzite sand inhabited by fynbos elements, but are more commonly collected on bare rock outcrops or cliff faces within the formation.

Mosses are however, frequently collected in close association with mountain fynbos elements that occur on richer soils of mountain slopes and in valleys.

An indication of the mosses present in the fynbos was recently given by Schelpe (1970) in a provisional checklist of the bryophytes of the Cape Peninsula. The dominant mosses in the fynbos region are species of Sphagnaceae, Dicranaceae, Pottiaceae, Grimmiaceae and Bryaceae. The family Wardiaceae is endemic to the fynbos.

Desert/Karoo

Phytogeographically the arid and semi-arid regions of the southern and western parts of the Flora area are generally included in the Karoo-Namib region. This region includes areas of bleak deserts, with large expanses devoid of vegetation in the west, but it extends eastward into open dwarf-succulent shrublands. The vegetation becomes taller and woody on mountain slopes and along temporary water courses. Bryophytes are practically unknown from the drier desert areas of South West Africa/Namibia, and they are infrequently collected in the shrublands of the Karoo.

The majority of the mosses from the arid and semi-arid parts of the western Cape and southern South West Africa/Namibia are minute ephemerals of Ditrichaceae, Dicranaceae and Pottiaceae, only rarely collected by the most astute collectors. Species of Pottiaceae and Grimmiaceae are the most commonly encountered mosses in the Karoo of the central and southern Cape. Generally disguised by their greyish or blackish colour when dry, these species generally form extensive colonies on rocks or on soil below low shrubs. Although very infrequent, species of Funariaceae, Bryaceae and Fabroniaceae are occasionally encountered in denser vegetation or in protected rock crevices.

Grassland/savanna

The grasslands and savannas of the Zambezian Domain cover large expanses of the northern and eastern Flora area, and extend northward to cover most of southcentral and eastern Africa. Mosses are only occasionally found in the flatter areas throughout this region, but become much more frequent as elevation increases or where the vegetation is denser, especially around rock outcrops or on cliff faces. Members of the families Fissidentaceae, Ditrichaceae, Dicranaceae and Pottiaceae are the most commonly encountered, although Archidiaceae, Bryaceae, Orthotrichaceae, Fabroniaceae and Polytrichaceae are also present.

Composition of the moss flora differs in riverine situations or wooded areas along streams, where Bryaceae, Funariaceae and occasionally members of Hypnales are found. *Sphagnum* is frequently collected in the grassland/savanna formation in permanently wet habitats.

Woodland

Scattered throughout the grassland of the Zambezian Domain are numerous patches of woodland. As interpreted here, the woodland formation encompasses a wide range of vegetation types, i.e. from dense savanna to open dry forests. The mosses of the woodlands include many of the grassland taxa, but a higher percentage of the pleurocarpic families is characteristic of this formation.

As the woodlands become denser, either in kloofs or on mountain slopes, species of Erpodiaceae, Orthotrichaceae, Hedwigiaceae, Cryphaeaceae and Leskeaceae are frequently encountered. Members of the Hypnales are more common in the thicker woodlands around small mountain streams.

The wetter, high elevation woodlands of the escarpment in the eastern Transvaal and Drakensberg of Natal are distinct bryologically and more closely related to the forest flora.

Forest

In Southern Africa, natural forest exists as large or small remnants scattered from Table Mountain in the southwestern Cape, across coastal regions of the southern and eastern Cape, and into Natal. The forests extend northward along the escarpment of the eastern Transvaal and link up with the montane forests of eastern Africa.

The forest remnants vary in size from the larger Knysna and Amatola Forests in the Cape, to the tiny kloof forests of Natal. In addition, several forest types are represented in Southern Africa, i.e. montane, kloof-mist, lowland and coastal. Comparison of the bryophyte communities in each of these forest types is underway, but results are fragmentary at this time.

The forests support a large and diverse bryophyte flora. The most important difference from the woodlands is the higher frequency of members of the Isobryales and Hookeriales.

Alpine heath-grassland

Confined chiefly to the Drakensberg of Lesotho and adjoining parts of Natal, Orange Free State and eastern Cape, the alpine heath-grassland has a vegetation characterized by alpine grasses and dwarf shrubs. The elevation, high precipitation and, to some extent, soil types contribute to the unique status of this formation in Southern Africa. The extremely interesting bryophyte flora of the alpine region is particularly rich in species of Dicranaceae, Pottiaceae, Bryaceae, Bartramiaceae and Polytrichaceae. Numerous species with disjunct distributions are also known from the area, i.e. *Bryoerythrophyllum jamesonii, B. recurvirostrum, Bryum albopulvinata, B. cyathiphyllum* and *Abietinella abietina.*

Collecting, preservation, study and identification of the mosses of Southern Africa

Collecting

Most mosses can be collected at any time of the year, the one exception being the ephemerals of the drier regions. These tiny mosses are found only after the rainy season, e.g. September–October in Namaqualand. Different periods of fertility within the mosses will result in the production of sporophytes on some species, during any part of the year.

Bryophytes are found throughout Southern Africa, from the wet forest in the east to the arid deserts of the west and from the Cape fynbos to the Okavango Swamps in Botswana.

The mosses in dense, wet forests are large and easily collected; consequently they are also the best-known part of the moss flora. As precipitation decreases, the frequency, size and prominence of the mosses also decrease. Changes in growth strategies and habitat preference are also obvious.

The collecting of bryophytes is relatively simple when compared with other forms of biological collecting. This is partly due to their small size, but also to the fact that practically no field preparation is necessary. The most convenient collecting method employs small paper bags, of c. 250 g–1 kg size, as specimen containers. Samples are generally removed from the substrate by hand or with a small knife. A 10x hand lens is useful for initial observations. Excess soil, humus or bark should be removed and a single collection placed in a paper bag.

Various methods are used for numbering specimens and recording the collecting locality and substrate information. The most reliable procedure is to record all of this information on the collecting bag. To save time, larger paper bags can be used to store all of the collecting bags from a single locality and individual collection numbers may be added at a later time. The substrate data must be noted as accurately as possible on each bag when the collection is made.

It is very important to air-dry the specimens, as soon as possible, to avoid fungal growth. For this reason plastic bags should be avoided when collecting or for storing field collections.

It must be emphasized that mosses represent an important part of any ecosystem not only aesthetically but ecologically. Judicious collecting should always be undertaken with the knowledge that mosses grow very slowly. Entire colonies may be eradicated as a result of damage caused by sampling, or they may take many years to recover.

Preservation

Mosses require minimal preparation before being identified or preserved as herbarium specimens. Large, bulky specimens can be made pliable by wetting. After these specimens are divided or folded to conform to packet size, they should be *lightly* pressed and dried between sheets of blotting paper. This procedure should be avoided when dealing with very small specimens. A fine soil sieve will remove excess soil, without disturbing delicate cushions or specimens collected on crusts of soil.

The mosses are well suited to storage in a packet system, whether the packets are kept separately or mounted on herbarium sheets. Vertical file packet systems are not only curatorially practical, but less expensive in both material and space. Containers used for the filing of specimens can be as simple as a group of shoe boxes or as elaborate as specially made boxes in broad-side filing cabinets (cf. Magill, 1980). Mounting bryophytes exposed on herbarium sheets should be avoided.

Herbarium packets for bryophytes can be made to fit the size of an available box or cabinet or designed to suit the collector. A useful standard packet can be made from an A4 piece of paper. The quality of the paper should be such that packets will last for many years.

The moss packet

(1) Place a sheet of A4 paper on a flat surface. Bring the lower edge of the paper upward 100 mm for the first fold, square the sides and crease the fold;

(2) fold each side over 35 mm, square the lower edges, then crease each of the side folds;

(3) fold the top downward to c. 7–8 mm above the bottom of the packet; square the sides and crease the fold.

This will result in a 104 × 138 mm packet suitable for most vertical file packet systems.

Collecting data for individual specimens (substrate, precise locality and altitude, surrounding vegetation, date, collector and number, and name of the moss) should be written on the outer flap or a label with this information can be glued to the flap. Some collectors have the paper pre-printed so that when it is folded into a packet, the outer flap has a label in place, ready for inscription of the information.

Study and Identification

Techniques used in the study and identification of mosses vary widely and undoubtedly collectors, undertaking the identification of their own specimens, will modify the techniques discussed here. The following method should be regarded as a starting point only.

A dissecting and a compound microscope, as well as the standard materials for preparing microscope slides, are needed for the identification of mosses. Two pairs of fine-tipped forceps and a sewing needle secured in a wooden handle are useful for the dissection of specimens. A razor blade or scalpel is required to make transverse or longitudinal sections of stems, leaves or capsules.

Before dissection begins, the specimen should be examined and notes should be made of habit, colour, position and curvature of leaves and, if present, the position and structure of the sporophyte. A single plant, or perhaps two or more, depending on size, should be wet in a drop of water at one end of a slide; some scientists prefer to use a beaker of boiling water to wet specimens. Either method will work. Position and curvature of the wet leaves should again be noted.

Under the dissecting microscope, leaves from the upper stem are removed using both pairs of forceps. One pair of forceps should be used to hold the stem in place and the other either to scrape leaves off the stem (in a motion from the apex downward) or to pick off

individual leaves (care should be taken to grasp the leaves at the insertion with the stem). Perichaetial and perigonial leaves should not be mixed with the vegetative leaves, but segregated with the sporophyte until later.

Free-hand sectioning of moss leaves or stems is never easy and beginners may make numerous attempts before obtaining usable sections. Several methods of sectioning have been published (Flowers, 1973; Scott & Stone, 1976; Zander, 1979a). Although all these methods produce results, they tend to be rather hit or miss. In order to fully use all of the characters available from leaf or stem sections, this Flora requires very precise sectioning, frequently in specific areas of the leaves or stems.

In the method employed during preparation of the Flora a leaf is placed in a small drop of water at the corner of a slide. Depending upon whether proximal or distal sections are required, the apex or base of the leaf is held down with a pair of forceps or needle. Under the highest magnification of the dissecting microscope, a single edge razor blade is employed in a slow rocking motion over the leaf, across the corner of the slide. Careful positioning of the blade will quickly produce precise, thin sections from various parts of the leaf. A similar technique is used when stem and capsule sections are needed.

The detached leaves and sections are moved to another slide and placed into a drop of water or mounting medium. A cover glass is then applied. As stated earlier the perichaetial leaves and sporophyte should be kept separate from the vegetative leaves. When making a permanent slide it is a good practice to have the two under separate cover slips, on the same slide.

Wetting of the capsule frequently requires additional manipulation, i.e. boiling water or a small drop of alcohol to wet the peristome and contents of the spore sac. In most cases the capsule is too large to be mounted whole under a cover slip. The following procedure is useful for obtaining the necessary parts.

The capsule is secured by forceps at a corner of the slide. The mouth and, if present, associated peristome, is severed near the top of the urn. The resulting ring of the mouth is then divided into 2–4 parts, being careful not to damage the peristome teeth. The urn should then be sectioned lengthwise to produce a long narrow strip of the exothecial cells. The mouth parts, urn section, perichaetial leaves and any other associated parts, are then transferred to a drop of water or mounting medium and covered by a cover glass. Some of the mouth parts should face up and others down so that both surfaces of the peristome teeth can be seen. Spores are generally carried with parts of the capsule, however occasionally capsules must be searched for a few spores. When permanent slides are made, the remainder of the capsule and attached seta can be placed in the mounting medium alongside the cover slip for later reference.

Mosses are commonly identified from water-mounted preparations, however, a set of permanent microscope preparations is continuously useful for comparison, especially if slides are properly labelled with names and reference numbers. Although a variety of mounting media is available, Hoyer's medium is widely used in bryology becaues of its water solubility, clearing quality and simple recipe.

To prepare Hoyer's medium: (1) very slowly dissolve 30 g of gum arabic (preferably flake type) in 50 ml of distilled water at room temperature. This is most easily accomplished in a 500 ml beaker on a magnetic stirrer, over 2–4 hours; (2) add 200 g of chloral hydrate, stir until dissolved, then allow to stand till clear; (3) add 20 ml of glycerine and stir slowly; (4) the solution should be kept in an air-tight container and small amounts decanted into a dropper bottle when needed.

Occasionally moss leaves shrink or contort when transferred directly from water to Hoyer's medium. Although the leaves generally respread quickly, problem groups, i.e. *Funaria* and *Rhodobryum*, can be treated in a graduated series of glycerine/water when necessary.

The slides can be used immediately, but the medium will only harden over 1–2 weeks at room temperature. The resultant semi-permanent slide will remain usable for many years;

ringing the cover slip with nail varnish will make the slide virtually permanent. All measurements and observations in the Flora were made from specimen preparations mounted in Hoyer's medium.

Characters used in keys and descriptions of mosses

Plants. Characters describing the habit are somewhat subjective and generally represent an impression of size, growth form and colour obtained from the specimens examined. The substrate preference is taken from field observation and label information when available. The size calegories, used in the descriptions, are roughly equated with the following list. Some deviation may occur, especially where taxa span more than one category.

Plant size categories

Minute	<1 mm high
Small	<10 mm high or long
Medium	10–30 mm high or long
Large	30–60+ mm high or long
Robust	>70 mm high or long but also referring to thick or full plants.

Stem. Transverse sections of stems are only infrequently required for identification of mosses of this fascicle. One important exception is *Sphagnum* where the number of layers of the stem hyalodermis is taxonomically important. In a few families, presence or absence of a central strand is significant at the generic level. Ornamentation or unusual differentiation of the stem surface cells are infrequent in taxa treated in this fascicle.

Leaves. Position and curvature of leaves are frequently important in identification and should be observed in both dry and wet condition. Leaf size and shape, cited in the keys and descriptions, are taken from leaves above the middle of the stem but below the apex, unless otherwise stated. Basal stem leaves, perigonial and perichaetial leaves are frequently distinct from the vegetative leaves; where appropriate, these leaves are also described.

Leaf length always indicates total length from base to apex. When necessary for identification, lengths of parts such as subula or base are given separately, in addition to total leaf length. Awns, however are not included in leaf length, but are recorded separately under the costa.

Leaf shape refers to the lamina as a whole. Apical and basal shapes refer only to the extreme tip or base of the leaf, respectively.

The leaf sections referred to in keys, descriptions and illustrations are cross sections from the upper middle of the leaf, unless otherwise stated.

Costa. The length and strength, surface structure and anatomy of the costa provide many important characters for the identification of the mosses in this fascicle. It is therefore generally necessary to examine leaf sections when identifying the mosses of this fascicle.

Laminal cells. There are generally two, but occasionally many, differentiated cell regions in a single leaf. Laminal cells and basal cells are the two types most frequently encountered and are generally described. The shape of the laminal cells was taken from an area of the upper third of the leaf, midway between the margin and centre-line. Basal cells are described from a similar area in the lower part of the leaf, but above the cells at the insertion. Cell ornamentation and thickenings were observed in surface view and in transverse sections. Cell measurements refer to the long axis unless otherwise stated.

Sporophyte. Shape and curvature of the capsule and seta are frequently important for identification, and should be noted both wet and dry whenever possible. The shape of exothecial cells and stomatal type and position are less important, but can be useful in identifying some specimens.

Size, shape and ornamentation of the peristome teeth are important at all levels of classification and should be studied when available. Presence or absence of a peristome is frequently critical in identification. Fragile peristomes quickly break away giving the impression of a gymnostomous capsule. Therefore capsule mouths should be routinely checked for remnants of the old peristome.

The operculum and calyptra of mosses in this fascicle can generally be studied under the dissecting microscope and need only rarely be included on slides. When the operculum or calyptra are important for identification, they are usually large enough to be easily observed under the dissecting microscope, e.g. *Encalypta, Bryobartramia.*

Spores are generally very uniform in size, shape and ornamentation. They are occasionally very ornate (*Trematodon, Bruchia*) or differ significantly in size or shape between species (*Archidium, Fissidens*). Spore measurements refer to maximum diameter unless otherwise stated.

Illustrations

All illustrations were prepared by Mrs Rita Weber using pencil as the medium. A very fine, soft lead (0,3 mm HB) was employed to give the sharp line necessary for reproduction, but also to allow for the shading that makes pencil such an attractive medium for bryophyte illustrations.

The habit drawings and their enlargements were prepared by the artist by direct observation of selected, generally wetted plants, using a dissecting microscope. All other parts were drawn from photographs, taken by the author, using a photographic apparatus attached to a compound microscope. The dissected specimens, used for photography, were mounted in Hoyer's medium.

GLOSSARY

abaxial—the side away from the stem or axis back or lower surface of a leaf (opposed to *adaxial*); see *dorsal*.

acaulescent—essentially stemless or apparently so.

acrocarpic—gametophyte producing sporophyte at apex of a stem or main branch (opposed to *pleurocarpic*). Acrocarpous mosses generally grow erect in tufts (rather than mats) and are sparsely branched.

acumen—a slender, tapering point.

acuminate—slenderly tapered. Fig. 1: 16.

acute—with angle of less than 90°. Fig. 1: 15.

adaxial—toward the stem or axis, upper surface of a leaf (opposed to *abaxial*); see *ventral*.

alar cells—group of cells at the basal margins of a leaf, at insertion; occasionally strongly differentiated; e.g. *Dicranoloma*.

amplexicaul—clasping the stem.

anisophyllous—either bearing two distinct types of leaves, e.g. *Hypopterygium* and *Racopilum*; or having stem and branch leaves obviously dissimilar, e.g. *Porothamnium* and *Thuidium* (opposed to *isophyllous*).

annulus—a ring of differentiated cells between the mouth of the capsule and the operculum, aiding in dehiscence.

antheridium—the male sex organ, a globose to broadly cylindric, stalked structure containing sperms (antherozoids); see *perigonium*.

apiculate—abruptly short-pointed (*mucronate* is shorter; *cuspidate* is longer and stouter).

apiculus—a short, abrupt point.

appendiculate—with short, transverse projections (appendiculae); see also *trabeculate*.

appressed—closely applied, as in leaves to the stems.

archegonium—the female sex organ, a flask-shaped structure producing an egg; see *perichaetium*.

arcuate—curved.

areolation—the cellular network of a leaf.

aristate—bristle-pointed, ending in an awn; see *hair-point*.

articulate—with thickened joints, jointed.

ascending—pointing obliquely upward.

attenuate—slenderly tapering.

auriculate—with auricles.

auricle—a small, ear-like lobe at the basal margins of a leaf.

autoicous—with archegonia and antheridia in separate inflorescences on the same plant; *cladautoicous*—with the male inflorescence on a separate branch; *gonioautoicous*—with the male inflorescence bud-like and axillary on the same stem or branch as the female inflorescence; *pseudautoicous*—with dwarf male plants epiphytic on the female; *rhizautoicous*—with the male inflorescence on a very short branch attached to the female stem by rhizoids and appearing to be a separate plant.

awn—a hair-point, usually formed by an excurrent costa; e.g. *piliferous* leaves of *Tortula*.

axil—the angle between leaf and stem.

axillary—in the leaf axils.

axillary hairs—uniseriate filaments found in leaf axils, generally inconspicuous and concealed by the leaf bases.

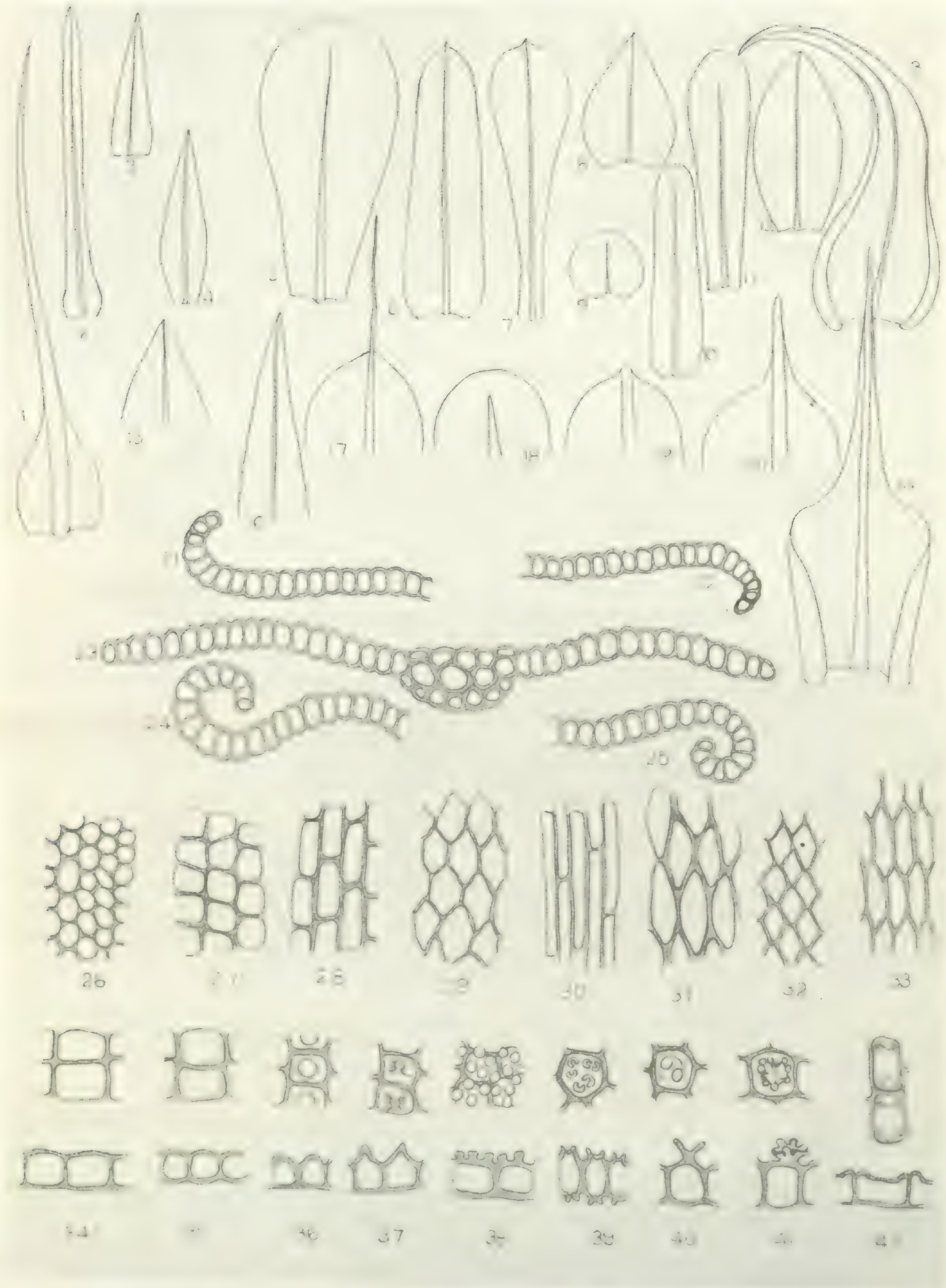
basal cells—cells of the lower $\frac{1}{4}$ to $\frac{1}{3}$ of a leaf, between margin and costa (opposed to *laminal cells*).

basal membrane—in Haplolepideae a short tube or cylinder of the peristome generally supporting numerous teeth; e.g. *Tortula*. In Diplolepideae a delicate but often well-developed membrane at the base of the inner peristome, commonly terminating in segments and cilia.

beak—the prolonged apex of an operculum.

bordered—having margins differentiated from the rest of the lamina in shape, size, colour, or thickness of cells; see *limbidium*.

brood-body—reduced bud, leaf or branch (*propagulum*); e.g. *Tortula pagorum*; or small, globose, ellipsoidal, or cylindrical to filamentous, septate bodies (*gemmae*); e.g. *Barbula indica;* serving in vegetative reproduction.



bloom—a powdery or waxy covering.

bulbiform—bulb-shaped.

caespitose—tufted, growing in cushions or sods.

calyptra (pl. calyptrae)—a membranous hood over the developing sporophyte, developed from the upper part of the archegonium; in true mosses ruptured near the base, carried upward by the elongation of the seta, and continuing growth to form a cap over the capsule; see *epigonium*. Fig. 2: 1.

campanulate—bell-shaped.

canaliculate—channeled.

cancellate—lattice-like.

cancellina (pl. cancellinae)—sharply defined, large, empty, and usually hyaline basal leaf cells of the Calymperaceae.

capsule—the spore case, or sporangium, often differentiated into an upper spore-bearing urn and a sterile basal portion, the neck. Fig. 2: 1.

cartilaginous—firm and tough.

catenulate—chain-like.

caulescent—having a stem.

central strand—a small group of elongate cells forming a central axis of some stems, usually thin-walled or coloured in transverse section. Fig. 2: 6.

cernuous—nodding or drooping.

chlorocyst—small, elongate, green cells forming a network surrounding the large, hyaline cells (*leucocysts*) of a *Sphagnum* leaf; also applied to small, green cells enclosed by layers of hyaline cells in the leaves of *Leucobryum*.

chlorophyllose—green, containing chlorophyll.

cilia—delicate, thread-like structures alternating with the segments of the inner peristome of many mosses; also applied to hair-like appendages fringing leaves or calyptrae. Fig. 2: 3.

ciliate—fringed with hairy appendages.

circinate—curved in a circle.

cladautoicous—see *autoicous*.

clavate—club-shaped.

cleistocarpic—referring to indehiscent capsules lacking an operculum or valves and hence opening irregularly (opposed to *stegocarpic*); e.g. cleistocarpous capsule of *Bruchia* and *Archidium*.

cochleariform—rounded and deeply concave, shaped like the bowl of a spoon.

collenchymatous—with cell walls more strongly thickened at the corners; thickenings called trigones.

columella—the central sterile tissue in a capsule around which the spores develop.

commissure—margin; in leaves of *Sphagnum*, the junction between the adjacent walls of hyalocyst and chlorocysts; pores along the commissures are thus arranged along the lateral margins of hyalocysts.

comose—hairy; but used by bryologists to refer to larger and more crowded leaves forming tufts or comae at the stem tips; e.g. *Campylopus*.

complanate—flattened together or compressed in 1 plane; e.g. *Fissidens*.

complicate—folded lengthwise.

complicate-carinate—sharply folded along a keel.

conduplicate—strongly folded along the middle; e.g. *Eustichia*.

constricted—abruptly narrowed.

contorted—bent into irregular curves, irregularly twisted.

FIG. 1.—**Leaf shapes** (1–14): **1.** setaceous above an ovate base, **2.** linear, **3.** triangular, **4.** lanceolate, **5.** obovate, **6.** oblong, **7.** spathulate, **8.** ovate, **9.** orbicular, **10.** ligulate, **11.** lingulate, **12.** elliptical, **13.** falcate, **14.** subulate above an oblong, clasping base. **Leaf apices and costal lengths** (15–20): **15.** acute with percurrent costa, **16.** acuminate with percurrent costa, **17.** obtuse with excurrent costa, **18.** rounded with costa ending below apex, **19.** mucronate apex, **20.** cuspidate apex. **Marginal curvature of laminae seen in cross section** (21–25): **21.** incurved (left lamina only), **22.** recurved (right lamina only), **23.** plane (complete cross section). **24.** involute (left lamina only), **25.** revolute (right lamina only). **Laminal cell shapes** (26–33): **26.** rounded, **27.** quadrate, **28.** rectangular, **29.** hexagonal, **30.** linear, **31.** fusiform, **32.** rhombic, **33.** oblong-hexagonal (rhomboidal). **Laminal cell ornamentation seen in superficial view** (above) **and cross section** (below) (34–42): **34.** flat and smooth, **35.** slightly bulging and smooth, **36.** mammillose, **37.** sharply mammillose, **38.** papillae low and blunt, **39.** papillae C-shaped, **40.** papillae bifid (spinose), **41.** papillae crown-shaped, **42.** cells prorate.

convolute—rolled together and forming a sheath.

cordate—heart-shaped.

cortex—differentiated outer layers of a stem or branch, occasionally surrounding a central strand.

cortical—referring to the outer cells of stem or branches, frequently differentiated into inner and outer layers. Fig. 2: 6.

corticolous—growing on bark.

cosmopolitan—occurring in all major floristic zones of the world.

costa—nerve or midrib of a leaf, sometimes double.

costate—with a costa.

crenate—with rounded teeth.

crenulate—with minute, rounded teeth.

cribrose—finely perforated.

crisped (crispate)—wavy (like crisp bacon); often used more loosely to mean variously curled, twisted and contorted.

cryptopore—immersed stoma, with the guard cells sunken below the level of the exothecial cells and often ± covered by them (opposed to *phaneropore*).

cucullate—hooded or hood-shaped; a cucullate calyptra is conic and split up 1 side, resembling a monk's hood; also used to describe leaves concave at the tips (cf. *mitrate*); e.g. *Tortula, Campylopus*.

cupulate—cup-shaped, rounded and swollen; e.g. capsule of Gigaspermaceae.

cushion—a closely-packed aggregate of plants with stems ± erect, but somewhat radiating at edges; e.g. *Grimmia*.

cuspidate—ending abruptly in a stout, rigid point; cf. *apiculate*. Fig. 1: 20.

cyathiform—cup-shaped, slightly wider at top; e.g. capsules of *Phasconica*.

cygneous—curved downward like a swan's neck.

cymbiform—concave and broadly boat-shaped.

deciduous—falling off, caducous.

decumbent—lying prostrate but with ascending tips.

decurrent—with margins extending down the stem below the leaf insertion as ridges or narrow wings.

dehiscent—splitting open, referring to capsules opening by valves (or by an *operculum*); e.g. *Andreaea*.

dendroid—branched above a trunk-like stipe and resembling a tree; e.g. *Porothamnium*.

dentate—with sharp teeth directed outward; see *tooth*.

denticulate—finely dentate.

deoperculate—referring to a capsule after the operculum has fallen.

depauperate—poorly developed.

dextrorse—twisted to the right (opposed to *sinistrorse*).

diaphanous—transparent.

dimorphic—of two forms.

dioicous—with archegonia and antheridia on separate plants, dioecious.

distal—away from the base or point of attachment (opposed to *proximal*).

distichous—in 2 opposite rows; e.g. *Fissidens, Distichium*.

divisural line—the median line of a peristome that is usually zig-zag, sometimes furrowed.

dorsal—the back, lower, or *abaxial* surface of a leaf; the upper surface of a prostrate stem; or the outer surface of a peristome tooth (opposed to *ventral*).

dorsal lamina—in *Fissidens* the portion of the leaf blade at the back of the costa, opposite the sheathing base (cf. *vaginant laminae*).

dorsal plates—the outer surface of exostome teeth.

dorsiventral—flattened, with distinct upper and lower surfaces.

echinate—roughened by blunt, spiny projections.

ecostate—without a costa.

elliptical—essentially oblong with convex sides or ends. Fig. 1: 12.

emarginate—broad at apex and shallowly notched; e.g. *Tortula*.

emergent—partially exposed, referring to capsules only partly exposed beyond tips of perichaetial leaves.

endemic—limited to a single country or floristic area.

endostome—the inner peristome (usually consisting of segments, frequently alternating with cilia, above basal membrane); e.g. Diplolepideae. Fig. 2: 3.

entire—without teeth, ± smooth, generally referring to leaf margins.

epigonium—protective envelope of the developing sporophyte before it ruptures into two parts, a *vaginula* that encircles the base of the seta and foot of the sporophyte, and a *calyptra* that covers the capsule. *Bryobartramia* has a persistent epigonium.

epiphragm—a circular membrane formed by the expanded tip of the columella, partially closing the mouth of the deoperculate capsule; e.g. *Polytrichum* and *Funaria*.

epiphyllous—growing on leaves of higher plants.

equitant—straddling, referring to the conduplicate and strongly sheathing leaf bases of *Fissidens*.

erect—upright.

erect-spreading—patent, spreading at an angle of 45° or less; cf. *spreading*.

erose—irregularly notched or ragged, as though gnawed.

excurrent—referring to a costa that extends beyond the apex. Fig. 1: 17.

exostome—the outer peristome, consisting of teeth; e.g. Diplolepideae. Fig. 2: 3.

exothecium—the outermost layer of the capsule wall, consisting of exothecial cells.

exserted—projecting and exposed, referring to capsules projecting above tips of perichaetial leaves.

falcate—curved like the blade of a sickle. Fig. 1: 13.

falcate-secund—strongly curved and turned to one side.

fasciculate—bunched together, in bundles or fascicles; e.g. branches of *Sphagnum*.

fibrillose—with fine, fibre-like wall thickenings (fibrils); applied to hyaline cells of *Sphagnum* where the fibrils may be spiral or annular.

filiform—slender and elongate, filamentous, thread-like.

fimbriate—fringed.

flaccid—soft, limp, flabby.

flagellum—a slender branch; referring to minute, axillary brood-branches and sometimes to long, slender, tapering stems (flagellate).

flexuose—slightly and irregularly bent, twisted, or wavy.

foot—the basal absorbing organ of the sporophyte.

foveolate—marked with small pits; e.g. spores of *Bruchia foveolata*.

frond—the branched part of a dendroid or frondose moss.

frondose—closely and regularly branched in one plane (pinnate), resembling a fern frond; e.g. *Thuidium*.

fruit—the capsule or more loosely the sporophyte.

fugacious—vanishing or readily falling away.

fusiform—narrow and tapered at both ends, spindle-shaped. Fig. 1: 31.

gametophore—the leafy phase of the gamete-bearing generation, produced from buds on the *protonema*.

gametophyte—the dominant, sexual generation; in mosses, the green, leafy plant.

gemma (pl. gemmae)—a small, globose, elliptic, or cylindric body of a few cells serving in vegetative reproduction; see also *brood-body* and *propagulum*.

gemmiferous—bearing gemmae.

gemmate—bud-like.

glabrous—smooth; neither papillose, rough nor hairy.

glaucous—with a whitish, greyish, or bluish bloom.

globose—spherical.

granulose (granulate)—roughened with minute, blunt projections; minutely grainy.

gregarious—growing close together but not in tufts or mats.

gonioautoicous—see *autoicous*.

guide cells—large, empty, rather thin-walled cells in a median row as viewed in the cross section of the costa of many mosses. Fig. 2: 4–5.

gymnostomous—lacking a peristome.

gynoecium—the female inflorescence; see *perichaetium*.

habit—the aspect or general appearance of a plant.

habitat—local environment.

hair-point—see *awn* and *aristate*, e.g. *Grimmia laevigata*.

heterogeneous—dissimilar (opposed to *homogeneous*).

heteroicous—with several forms of inflorescence on the same plant (or on various plants of the same species); also called *polyoicous*.

heteromallous—pointing in all directions (opposed to *homomallous*).

hispid—with short, stiff hairs; bristly.

hoary—whitish or greyish, usually referring to plants with leaves long hair-pointed; e.g. *Grimmia*.

homogeneous—uniform (opposed to *heterogeneous*).

homomallous—pointing the same way (opposed to *heteromallous*).

hyaline—colourless and transparent.

hyalocyst—large, empty, colourless water-storage cell, surrounded by a network of green chlorocysts; see also *leucocyst*; e.g. *Sphagnum* leaves.

hyalodermis—a cortex of large, empty, colourless cells (*hyalocysts*); e.g. *Sphagnum*.

hydroids—tracheid-like conductive cells in the axial strand of many mosses, sometimes also in the costa but not usually in contact with the central strand.

hymenostomaceous—peristome lacking but capsule mouth closed by an ephemeral membrane developed from the top of the columella.

hypophysis—a swollen neck at the base of the capsule (also called apophysis).

imbricate—closely appressed and overlapping.

immersed—completely covered; referring to capsules exceeded by the tips of the perichaetial leaves.

incised—cut into sharp divisions separated by narrow sinuses.

incrassate—thickened.

incurved—curved upward and inward, applied to leaf tips and margins (opposed to *recurved*); cf. *erect*. Fig. 1: 21.

inflexed—bent upward and inward, applied to leaf margins (opposed to *reflexed*).

inflorescence—a cluster of sex organs and the leaves or bracts surrounding them; see also *perichaetium* and *perigonium*.

innovation—a new shoot; a branch formed after the maturity of sex organs, usually at the base of an inflorescence.

insertion—the place of attachment of a leaf, branch, or peristome.

internal cylinder—central axis of *Sphagnum* stem, inside hyalodermis; cf. *central strand*.

involute—rolled upward and inward, applied to leaf margins (opposed to *revolute*). Fig. 1: 24.

irregular—asymmetric.

isodiametric—about as broad as long (including square, rounded, or hexagonal).

isophyllous—stem and branch leaves similar (opposed to *anisophyllous*).

julaceous—smoothly cylindric, like a catkin, referring to stems or branches with crowded and imbricate leaves.

juxtacostal—adjacent to costa.

keeled—sharply folded along the middle, like the keel of a boat.

lacerate—deeply and irregularly slashed or torn.

laciniate—dissected into fine, deep, irregular divisions (laciniae); ciliate-fringed.

lamella (pl. lamellae)—green ridges or plates on the costa or lamina of some moss leaves.

lamina (pl. laminae)—the leaf blade (as distinguished from the *costa*).

laminal cells—cells of the upper $\frac{1}{4}$–$\frac{1}{3}$ of a leaf, between the margin and costa (opposed to *basal cells*).

lanceolate—lance-shaped, narrow and tapered from the base (narrowly ovate-acuminate). Fig. 1: 4.

lateral—at the side (opposed to terminal).

lax—soft or loose; usually referring to large, thin-walled cells, but also the nature and spacing of leaves on stem, or stems in tufts.

lenticular (lentiform)—doubly convex, lens-shaped; cf. gemmae of *Oedipodiella*.

leptoid—conductive cell, somewhat similar to sieve tubes in form and function, found in the axial strand of stems and setae of Polytrichaceae and in setae of many other mosses.

leptome—a phloem-like tissue consisting of leptoids and parenchymatous cells.

leucocyst—large, empty, hyaline leaf cells of *Sphagnum* and *Leucobryum*; see also *hyalocyst*.

lid—operculum.

ligulate—strap-shaped; narrow, moderately long, with parallel sides. Fig. 1: 10.

limbate—with a limbidium; e.g. *Fissidens*.

limbidium—a border of elongate, incrassate, marginal leaf cells that are distinct from other laminal cells; e.g. *Fissidens*.

linear—very narrow, elongate, with nearly parallel sides (narrower than *ligulate*). Fig. 1: 2 & 30.

lingulate—tongue-shaped; oblong with a slightly broadened apex. Fig. 1: 11.

lumen—the cell cavity.

lunate—(lunulate)—crescent-shaped.

mammilla (pl. mammillae)—a bulging protuberance.

mammillose (mammillate)—convex with a blunt central projection. Fig. 1: 36–37.

mat—a densely interwoven, horizontal form of growth; e.g. *Brachythecium, Hypnum*.

micrometre—one-thousandth of a millimetre, micron (abbreviated—μm).

midrib—a mid-vein or single costa.

mitrate (mitriform)—conic and undivided or equally lobed at base, similar to a bishop's mitre, referring to calyptrae, cf. *cucullate*; e.g. *Grimmia, Ptychomitrium*.

monomorphic—of a single form.

monoicous—with antheridia and archegonia on the same plant, including *autoicous, paroicous, polyoicous* and *synoicous* (opposed to *dioicous*).

monopodial—main stem of unlimited growth; sex organs produced on lateral branches (opposed to *sympodial*).

mucro—a short, abrupt point.

mucronate—ending abruptly in a short point, usually caused by a shortly excurrent costa (*apiculate* is somewhat longer; *cuspidate* is even longer and stouter). Fig. 1: 19.

muticous—without a point or awn.

nanandrous—producing dwarf males.

neck—the sterile basal portion of a capsule, sometimes considerably differentiated, (opposed to *urn*) cf. *hypophysis*; e.g. *Trematodon*.

nerve—costa; midrib.

nodose—with knob-like thickenings, i.e. cell wall thickenings of Grimmiaceae.

nodulose—minutely knobbed.

oblate—wider than long.

oblong—rectangular. Fig. 1: 6 & 28.

obscure—indistinct.

obsolete—scarcely evident, almost lacking; usually referring to the costa.

obtuse—broadly pointed, more than 90°—used by some authors to mean blunt or rounded. Fig. 1: 17.

opaque—not transparent or translucent.

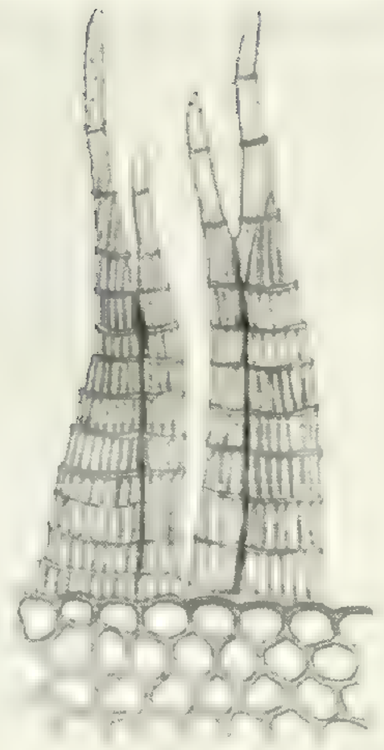
operculum—the lid covering the mouth of a moss capsule, falling at maturity to release the spores. Fig. 2: 1.

orbicular—nearly circular. Fig. 1: 9.

oval—shortly elliptical. Fig. 1: 12.

ovate—egg-shaped (with the basal portion broader than the apical portion). Fig. 1: 8.

panduriform—shaped like the body of a violin (obovate with a rounded sinus on either side).



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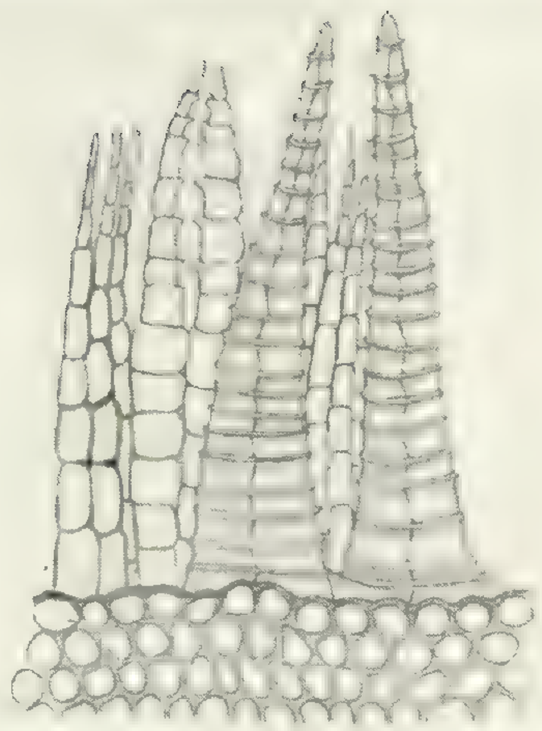

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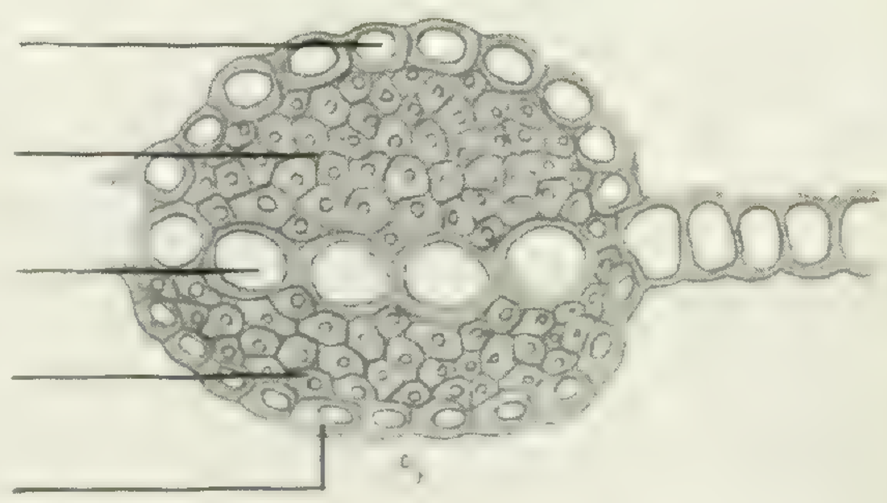

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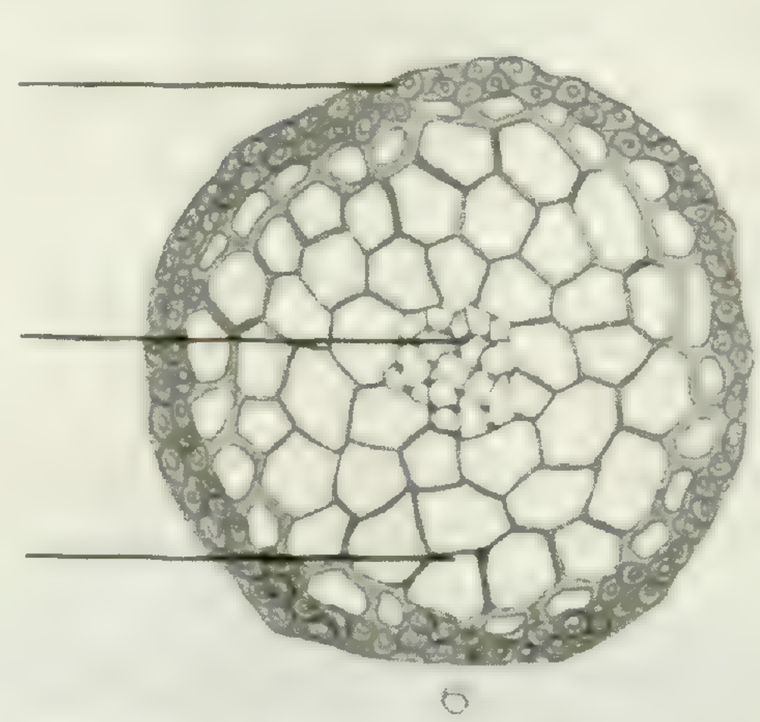

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FIG. 2.—**1.** Moss gametophyte and sporophyte. **2–3.** Peristome types: 2. single (haplolepidous), 3. double (diplolepidous). **4–5.** Costal cross sections. **6.** Stem cross section.

papilla (pl. papillae)—a minute protuberance of various forms. Fig. 1: 38–41.

papillose—roughened by 1 to many minute protuberances. Fig. 1: 38–41.

paraphyllia—small, green, filiform, lanceolate, leaf-like or sometimes branched scales; often produced on stems or branches of pleurocarpous mosses; e.g. *Thuidium*.

paraphyses—hyaline or yellowish, septate hairs mingled with the *antheridia* (and often with *archegonia*).

parenchyma—a tissue of relatively undifferentiated cells, usually thin-walled and isodiametric.

parenchymatous—composed of ± short cells joined end to end (opposed to *prosenchymatous*).

paroicous—with antheridia and archegonia in the same inflorescence but not mixed, the antheridia in the axils of uppermost and perichaetial leaves.

patent—erect-spreading.

pellucid—clear, translucent or transparent.

pendent—hanging.

pendulous—somewhat drooping, inclined more than horizontally; with stems and branches hanging, a growth form common in forests.

percurrent—referring to a costa that extends to the apex; cf. *excurrent*. Fig. 1: 15–16.

perichaetium (pl. perichaetia)—the female inflorescence, consisting of leaves and the enclosed *archegonia*.

perigonium (pl. perigonia)—the male inflorescence, a cluster of leaves and the enclosed *antheridia*.

peristome—a single (haplolepidous) or double (diplolepidous) circular structure inside the mouth of the capsule; in diplolepidous mosses the outer peristome (*exostome*) consists of teeth, the inner peristome (*endostome*) consists of segments, sometimes alternating with cilia, and often rising from a basal membrane. Fig. 2: 1–3.

phaneropore—superficial stoma, with the guard cells at the same level as other exothecial cells and not sunken in chambers (opposed to *cryptopore*).

phyllodioicous—nanandrous; with dwarf male plants resting on leaves or tomentum of the larger female plants.

phyllotaxy—the arrangement of leaves on a stem.

piliferous—hair-pointed; e.g. *awn*.

pilose—with long hairs; usually referring to leaves with long-excurrent costa.

pinnate—with numerous, spreading branches on 2 sides of the axis and thus resembling a feather.

pitted—with small openings or pores through the walls of adjoining cells, sometimes marked by conspicuous depressions in thick-walled cells (also called *porose*).

plane—flat, referring to leaf margins. Fig. 1: 23.

pleurocarpic—producing the sporophytes laterally from a perichaetial bud or a short, specialized branch rather than at the stem tips (opposed to *acrocarpic*); pleurocarpous mosses are usually prostrate, creeping and freely branched and grow in mats rather than tufts.

plicate—folded in longitudinal pleats (plicae).

plumose—closely and regularly pinnate; feathery.

polymorphic—of many forms, variable.

polyoicous—with antheridia and archegonia in separate inflorescences mixed together on the same plants (also called *heteroicous*).

pore—small opening or 'pit' in the walls of some cells, sometimes conspicuous as depressions in thickened walls between adjacent cells; in *Sphagnum* the pores are particularly large and conspicuous in the exposed walls of the leucocysts of branch leaves and also in outer stem cells; porose cell walls may be minutely or quite obviously perforated.

porose—pitted; see *pore*.

primary stem—the main stem, often creeping or rhizome-like with reduced or scale-like leaves.

processes—see *segment*.

procumbent—spreading, prostrate.

proliferous—continuing growth by the production of a new stem (or *innovation*).

propagulum (pl. propagula)—reduced bud, branch, or leaf serving in vegetative reproduction; see also *brood-body*.

prorate—with leaf cell ends projecting above the surface of the lamina giving a papillose appearance or with papillae (mammillae) borne at one or both ends of a cell (also called scindulose); e.g. *Philonotis*. Fig. 1: 42.

prosenchyma—a tissue made up of elongate cells with tapered ends.

prosenchymatous—with narrow, elongate cells overlapping at the ends (opposed to *parenchymatous*).

prostome (preperistome)—a rudimentary structure outside and usually adhering to the peristome teeth.

prostrate—creeping.

protonema (pl. protonemata)—green, branched filaments produced on germination of spores and giving rise to a leafy gametophyte; in *Sphagnum* and *Andreaea*, the protonema is ± thallose rather than filamentous; secondary protonemata are sometimes produced from broken leaves or stems of mosses.

proximal—near the base or point of attachment (opposed to distal).

pseudautoicous—see *autoicous*.

pseudoparaphyllia—small, unistratose, lanceolate or filiform structures resembling *paraphyllia*, often found in pleurocarpous mosses, in small numbers around branch primordia.

pseudopodium—an elongation of the gametophytic axis below the sporophyte in *Sphagnum* and *Andreaea*, serving the function of a seta; also applied to a similar extension of a stem tip bearing clusters of gemmae.

pseudopore—small spots somewhat resembling pores in leucocysts of *Sphagnum* branch leaves; consisting of fibril rings not enclosing a perforation.

pulvinate—cushion-like.

punctate—dotted, usually referring to spore markings.

pyriform—pear-shaped.

quadrate—square. Fig. 1: 27.

radicles—rhizoids; slender, non-chlorophyllose threads attaching the plants to the substrate, often covering stems, occasionally growing from leaf tips; the radicles of mosses usually have oblique cross-walls; cf. *rhizoids*.

radiculose—covered with rhizoids.

recurved—curved downward and inward; referring to leaf margins or tip, marginal teeth, or peristome teeth (opposed to *incurved*). Fig. 1: 22.

reflexed—bent down and inward, generally referring to leaf margins (opposed to *inflexed*).

regular—symmetric.

reniform—kidney-shaped.

repent—creeping.

resorption—disappearance or erosion of parts of cell walls (resorbed); e.g. *Sphagnum* leaves.

resorption furrow—a furrow produced by the resorption of the outer cell walls of the elongated marginal cells in leaves of some species of *Sphagnum;* seen in cross section as a C-shaped marginal cell.

reticulate—in a network.

retort cells—cells with a pore at the upper end, terminating a short, projecting neck, found in the hyalodermis of many species of *Sphagnum*.

retuse—with a slight indentation of a broad apex.

revoluble—rolling away, referring to an annulus which falls in a broken ring.

revolute—rolled downward and backward, referring to leaf margins (opposed to *involute*). Fig. 1: 25.

rhizautoicous—see *autoicous*.

rhizoids—simple or branched, septate filaments, dead at maturity, anchoring the plant and sometimes ± covering the stem; cf. *radicles*. Fig. 2: 1.

rhizome—a slender, horizontal, subterranean stem (also called subterranean stolon); e.g. *Rhodobryum*.

rhombic—diamond-shaped. Fig. 1: 32.

rhomboidal—longer than hexagonal, oblong-hexagonal. Fig. 1: 33.

rosette—a compact cluster of leaves encircling the stem.

rostrate—beaked.

rugose—transversely wrinkled or undulate.

rugulose—with weak, transverse wrinkles.

saxicolous—growing on rocks.

scabrous—rough.

scalpelliform—asymmetric and resembling the blade of scalpel.

scarious—dry and thin, scale-like or membranous.

secund—turned to one side.

segment—a tooth-like division of the inner peristome (*endostome*), also called *processes* Fig. 2: 3.

septate—divided by cell walls; having partitions.

seriate—in rows, e.g. uni-, bi-, multiseriate; applied to ranks of leaves on a stem, rows of cells or papillae, cf. *stratose*.

serrate—saw-toothed; with marginal teeth pointing forward.

serrulate—minutely serrate.

sessile—without a stalk or seta.

seta (pl. setae)—stalk supporting the capsule. Fig. 2: 1.

setaceous—bristle-like. Fig. 1: 1.

sheathing—surrounding and clasping the stem, the base of the seta or the capsule.

shoulder—the area where a leaf base is abruptly narrowed to the upper lamina.

sinistrorse—twisted to the left (opposed to (*dextrorse*).

sinuate (sinuose)—wavy.

sinuolate—minutely wavy.

spathulate—tapering proximally from a broad, rounded apex (similar to *lingulate* but more markedly narrowed from a broad apex). Fig. 1: 7.

spiculate—covered with fine points.

spinose—referring either to leaf margins or costae with sharply pointed teeth, e.g. *Syrrhopodon gomesii*; or very high, sharp leaf cell papillae, e.g. *Triquetrella tristicha*. Fig. 1: 40.

sporangium—the spore-sac of a capsule or, more loosely, the entire capsule.

spores—minute, mostly spherical, nearly always unicellular bodies produced in the capsule as a result of reduction division, giving rise on germination to protonemata Fig. 2: 1.

sporophyte—the spore-bearing generation; produced by the fertilization of an egg; remaining attached to the gametophyte and partially dependent on it, typically consisting of *foot*, *seta* and *capsule*.

spreading—an angle of 45° or more; cf. *wide-spreading*, *erect-spreading*, *squarrose*.

squarrose—spreading at right angles.

squarrose-recurved—spreading at right angles, with the tips curved downward.

stegocarpic—referring to capsules with operculum differentiated (opposed to *cleistocarpic*); e.g. stegocarpous capsules of *Ditrichum* and *Barbula*.

stellate—star-shaped.

stereids—slender, elongate, thick-walled fibre-like cells found in groups (stereid bands) in the costa of some mosses. Fig. 2: 4–5.

stipe—the unbranched part of an erect stem of dendroid or frondose mosses.

stoloniform—referring to slender, elongate, spreading branches or stems, with smaller bract-like leaves.

stoma (pl. stomata)—opening in the capsule wall, usually in the neck, surrounded by guard cells.

strangulate—deeply constricted, as below the mouth of a capsule.

stratose—in distinct layers; uni-, bi-, multistratose; e.g. bistratose leaves have laminal cells in two layers, cf. *seriate*.

striate—marked with fine, longitudinal ridges (striae).

striolate—finely ridged.

strict—straight and rigid.

strumose—with a goitre-like swelling (or struma) at the base, applied to some capsules.

strumulose—with a small or indistinct swelling at one side of the capsule base.

substereid—almost with the characters of a stereid, walls not as strongly thickened.

subula—a long, slender point.

subulate—slenderly long-acuminate. Fig. 1 : 14.

sulcate—strongly plicate, with deep longitudinal folds.

superficial cells—outer cells of the costa in surface view; cf. *surface cells*.

surface cells—outer cells of the costa as seen in cross section; i.e. *superficial cells* in cross section. Fig. 2: 4–5.

sympodial—main stem of determinate growth; sex organs produced at apex; main stem frequently branching from below apex (opposed to *monopodial*).

synoicous—with antheridia and archegonia in the same inflorescence.

systylious—with the operculum remaining attached to the tip of the columella after dehiscence.

teeth—divisions of a single peristome, Fig. 2: 2; or of the exostome of a moss with a double peristome, Fig. 2: 3; divisions of the endostome are called *segments;* see *tooth* and *dentate*.

teniola—intramarginal border of linear cells in the leaves; e.g. *Calymperes*.

terete—rounded in cross section.

terminal—at the apex (opposed to *lateral*).

terricolous—growing on soil.

tessellated—checkered, in a pattern of squares, applied to the basal membrane of the peristome of *Tortula*.

tetrad—a group of 4 developing or rarely mature spores.

tetrad scar—a triangular to almost circular feature occasionally obvious on the distal face of some spores, resulting from the contact between spores in a *tetrad* during cell wall deposition; e.g. *Bruchia* and *Trematodon*.

thallose—consisting of a flat plate of tissue, rather than filaments; see *protonema*.

tomentose—woolly, densely radiculose, covered by a tomentum of *rhizoids*.

tomentum—woolly hairs or radicles.

tooth—a division of the peristome, Fig. 2: 2–3; see *teeth*; also applied to irregularities or projections at the margins of leaves; see *dentate*.

tortuose—irregularly bent or twisted.

trabeculate—with projecting cross-bars (trabeculae) at the back of some peristome teeth; see *appendiculate*.

tristichous—in 3 rows; e.g. leaves of *Tristichium* and *Triquetrella*.

truncate—abruptly cut off or squared off at the apex.

tubulose—tube-like; usually referring to leaves with strongly incurved margins; e.g. *Campylopus*.

tuft—growth form with stems erect, radiating; small cushions; caespitose growth form.

turf—growth form with stems erect, parallel, often in extensive colonies.

turgid—plump or swollen.

uncinate—hooked.

undulate—wavy.

urceolate—urn-shaped; applied to capsules constricted below a wide mouth and abruptly narrowed at the base.

urn—spore-bearing portion of a capsule (opposed to *neck*).

vaginant laminae—in *Fissidens*, the equitant laminae at base of the leaf that clasp the stem and the base of the leaf above it; cf. *dorsal lamina*.

vaginula—the ring or sheath enveloping the base of the seta, derived from the base of the archegonium and remaining after the separation of the calyptra; see *epigonium*.

valve—one of the segments into which a capsule of *Andreaea* separates on dehiscence.

venter—the swollen basal portion of an archegonium, containing the egg.

ventral—the upper or *adaxial* surface of a leaf; the lower surface of a prostrate stem; or the inner surface of a peristome tooth (opposed to *dorsal*).

ventricose—bulging on one side below (like a stomach).

vermiculate—with minute worm-like ornamentation; e.g. spores of *Bruchia ecklo-niana*.

verruculate—irregularly roughened.

weft—a loosely interwoven, often ascending growth form; e.g. *Thuidium*.

whorled—arranged in a ring or circle.

widespreading—spreading at a wide angle, but less than 90°; cf. *spreading*.

CONSPECTUS OF CLASSIFICATION

The classification system used here is a linear model that inadequately expresses the relationships evident within the Musci.

The system is basically that of Fleischer (1902–22) and Brotherus (1924–25), modified to accommodate some more recent concepts and it represents an intermediate stance between the extremes of several published ordinal classifications.

It is obvious from recent research (vide Koponen, 1977; Edwards, 1979) that the classification of mosses needs realignment to conform with present concepts. This Flora is not considered the proper venue for such alterations.

DIVISION BRYOPHYTA

Fascicle 1:

CLASS SPHAGNOPSIDA

ORDER SPHAGNALES

Family Sphagnaceae

CLASS ANDREAEOPSIDA

ORDER ANDREAEALES

Family Andreaeaceae

CLASS BRYOPSIDA

ORDER DICRANALES

Family Fissidentaceae
Nanobryaceae
Archidiaceae
Ditrichaceae
Seligeriaceae
Dicranaceae

ORDER POTTIALES

Family Calymperaceae
Encalyptaceae
Pottiaceae
Bryobartramiaceae
Grimmiaceae

Fascicle 2:

ORDER FUNARIALES

Family Gigaspermaceae
Ephemeraceae
Funariaceae
Splachnaceae

ORDER BRYALES

Family Bryaceae
Mniaceae
Eustichiaceae
Rhizogonaiceae
Aulacomniaceae
Bartramiaceae

Fascicle 3:

ORDER ORTHOTRICHALES

Family Erpodiaceae
Rhachitheciaceae
Ptychomitriaceae
Orthotrichaceae
Rhabdoweisiaceae
Racopilaceae

ORDER ISOBRYALES

Family Fontinalaceae
Wardiaceae
Hedwigiaceae
Cryphaeaceae
Leucodontaceae
Prionodontaceae
Trachypodaceae
Pterobryaceae
Meteoriaceae
Phyllogoniaceae
Neckeraceae
Lembophyllaceae

ORDER HOOKERIALES
Family Hookeriaceae

Fascicle 4:
ORDER THUIDIALES
Family Fabroniaceae
Leskeaceae
Thuidiaceae
ORDER HYPNOBRYALES
Family Amblystegiaceae
Brachytheciaceae
Entodontaceae
Plagiotheciaceae
Hypnaceae
Hylocomiaceae
CLASS POLYTRICHOPSIDA
ORDER POLYTRICHALES
Family Polytrichaceae

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PROVISIONAL KEY TO THE FAMILIES OF FASCICLE 1

The following key is provided to allow access to the families treated in this fascicle. When necessary, couplets are also incorporated into the key, that refer to taxa which will only be treated in fascicle 2, 3 or 4. A key to all families represented in the Flora will be included in fascicle 4.

1 Plants pleurocarpic or of pleurocarpic habit or appearing acrocarpic but branches arising from a creeping stem or rhizome.....(Fascicles 2–4)

1 Plants acrocarpic or of acrocarpic habit:

2 Plants cleistocarpic, generally minute to small:

3 Plants acaulescent or nearly so:

4 Protonema persistent, plants scattered on protonema.....**EPHEMERACEAE** (Fascicle 2)

4 Protonema quickly disappearing or persistent only at base of individual plants:

5 Epigonium rupturing early; calyptra very small.....**POTTIACEAE** (p. 177)

5 Epigonium persistent or calyptra swollen, completely covering sporophyte:

6 Leaves ligulate to lingulate, 0,3–0,5 mm long; laminal cells small, papillose ..... **BRYOBARTRAMIACEAE** (p. 269)

6 Leaves larger, narrowly spathulate, 3–4 mm long; laminal cells lax, smooth .....**FUNARIACEAE** (Fascicle 2)

3 Plants with well defined stem:

7 Spores very large, 50–290 μm; capsules globose, exothecial cells with large brown spots at maturity.....**ARCHIDIACEAE** (p. 71)

7 Spores smaller, 10–15 μm; capsules globose to pyriform, exothecial cells variously coloured:

8 Capsules oval to globose, immersed.....**DITRICHACEAE** (p. 83)

8 Capsules elliptical to cylindrical or pyriform, emergent to exserted:

9 Capsule pyriform, neck well defined; spores ornate..**DICRANACEAE** (p. 105)

9 Capsule without neck; spores weakly papillose.....**POTTIACEAE** (p. 177)

2 Plants stegocarpic or capsules dehiscent through longitudinal valves:

10 Plants minute; leaves secund; capsules pendent, operculate, exserted laterally through leaves on arcuate seta.....**DITRICHACEAE** (p. 83)

10 Plants larger; seta occasionally arcuate but not exserting capsule laterally:

11 Plants reddish black to dark green occasionally greyish because of long hyaline awns; growing mostly on rock or stony soil:

12 Laminal cells papillose or mammillose; leaves always costate:

13 Laminal cells papillose.....**POTTIACEAE** (p. 177)

13 Laminal cells mammillose:

14 Lamina completely bistratose above base.....**PTYCHOMITRIACEAE** (Fascicle 3)

14 Lamina unistratose or only bistratose juxtacostally or marginally .....**POTTIACEAE** (p. 177)

12 Laminal cells smooth *or*, if papillose, leaves ecostate:

15 Leaves incurled, crisped to contorted dry, muticose: plants dark green, glossy..... **PTYCHOMITRIACEAE** (Fascicle 3)

15 Leaves appressed when dry, little contorted:

16 Plants blackish to reddish black, dull; leaves muticose; laminal cell walls straight, mostly irregularly thickened; capsule dehiscent through 4 longitudinal valves..... **ANDREAEACEAE** (p. 33)

16 Plants blackish green to greyish, occasionally glossy; leaves mostly piliferous or with hyaline tips; laminal cell walls sinuate or nodose, occasionally straight; capsules operculate....**GRIMMIACEAE** (p. 271)

11 Plants green to light green or yellowish green, occasionally whitish:

17 Laminal cells differentiated into small chlorocysts and large leucocysts:

18 Leaves unistratose; leucocysts surrounded by network of chlorocysts; leucocysts frequently fibrillose, generally with numerous pores on exposed walls.....**SPHAGNACEAE** (p. 23)

18 Leaves multistratose; chlorocysts enclosed by 2–8 layers of leucocysts:

19 Leaves plane above, recurved to squarrose dry; chlorocysts in distal section triangular, in two rows; capsules erect, symmetric; peristome teeth 8.....**CALYMPERACEAE** (p. 161)

19 Leaves concave above, appressed to contorted dry; chlorocysts in distal section rhombic, in single row; capsule curved, asymmetric; peristome teeth 16.....**DICRANACEAE** (p. 105)

17 Laminal cells not differentiated into chlorocysts and leucocysts:

20 Leaves with filaments or lamellae on ventral surface:

21 Plants medium to large or robust.....**POLYTRICHACEAE** (Fascicle 4)

21 Plants small to minute.....**POTTIACEAE** (p. 177)

20 Leaves without filaments or lamellae on ventral surface:

22 Leaves distichous or tristichous:

23 Leaves tristichous:

24 Leaves appressed wet or dry; laminal cells smooth.....**DITRICHACEAE** (p. 83)

24 Leaves spreading wet; laminal cells spinose-papillose.....**POTTIACEAE** (p. 177)

23 Leaves distichous and complanate:

25 Leaves with vaginant laminae clasping stem and a well-developed dorsal lamina .....**FISSIDENTACEAE** (p. 39)

25 Leaves without dorsal lamina:

26 Laminal cells papillose..... (Fascicle 2)

26 Laminal cells smooth:

27 Plants minute; leaves elliptical-subulate, to 1 mm long.....**NANOBRYACEAE** (p. 69)

27 Plants larger; leaves oblong-subulate, 3–4 mm long.....**DITRICHACEAE** (p. 83)

22 Leaves in many rows around the stem, not distinctly distichous or tristichous, occasionally complanate:

28 Laminal cells smooth:

29 Laminal cell walls sinuate to nodose.....**GRIMMIACEAE** (p. 271)

29 Laminal cell walls straight, occasionally strongly incrassate and pitted:

30 Alar cells differentiated, enlarged and hyaline to coloured:

31 Costa broad, occupying $\frac{1}{3}$ to $\frac{3}{4}$ width of leaf base..... **DICRANACEAE** (p. 105)

31 Costa narrow, occupying less than $\frac{1}{4}$ width of leaf base:

32 Leaves with narrow border of elongated, hyaline cells..... **DICRANACEAE** (p. 105)

32 Leaves without differentiated marginal cells..... **SELIGERIACEAE** (p. 103)

30 Leaves with alar and basal cells occasionally somewhat larger or hyaline, but alar cells not strongly differentiated:

33 Plants covered with glaucous bloom; growing in shallow caves or rock recesses..... **DITRICHACEAE** (p. 83)

33 Plants without glaucous bloom:

34 Stems julaceous, leaves clasping stem wet or dry, oval to orbicular..... **DICRANACEAE** (p. 105)

34 Leaves variously spreading wet:

35 Plants small to minute; leaves small, oval to ovate, piliferous, capsules gymnostomous, immersed or exserted, cupulate with very broad mouth; *or* leaves broad elliptical-apiculate, plants producing discoid gemmae at apex..... **GIGASPERMACEAE/FUNARIACEAE** (Fascicle 2)

35 Plants mostly larger; capsules not cupulate; gemmae, if present, on rhizoids or axillary on stem:

36 Peristome double, occasionally single or absent; leaves generally broad, acute to shortly acuminate, frequently crowded at apex, *if* leaves narrower, margins strongly toothed to doubly serrate; laminal cells generally lax .....(Fascicle 2)

36 Peristome single, rarely absent; leaves generally narrower; laminal cells smaller, quadrate to rectangular, mostly incrassate:

37 Plants corticolous or saxicolous, forming small tufts:

38 Plants corticolous; capsules cylindrical, emergent; peristome single or double; calyptra large, covering capsule **ORTHOTRICHACEAE** (Fascicle 3)

38 Plants saxicolous; capsules exserted; peristome single; calyptra small, mitrate..... **PTYCHOMITRIACEAE** (Fascicle 3)

37 Plants terricolous or on rock at waterfalls or seeps, gregarious or forming large turfs; capsules exserted, peristome single; calyptra small, cucullate:

39 Leaf apices obtuse to rounded; *or*, if acute, leaves widest above middle and margins crenulate to serrate..... **POTTIACEAE** (p. 177)

39 Leaf apices acute to acuminate or subulate:
40 Leaf margins bistratose above base:
41 Leaves lanceolate to ovate-acuminate, incurved dry.....**POTTIACEAE** (p. 177)
41 Leaves oval to oblong, subulate, flexuose to contorted dry.....**DICRANACEAE** (p. 105)
40 Leaf margins unistratose:
42 Leaf margins narrowly revolute above base to near apex *or* reflexed below, plane above:
43 Costa in section with well-defined ventral stereid band; capsule ± asymmetrical, generally curved and furrowed dry; peristome teeth lanceolate, c'eft to near base .....**DITRICHACEAE** (p. 83)
43 Costa in section without ventral stereid band, ventral cells in 2–3 layers, similar to guide cells, incrassate; capsule erect, cylindrical, smooth; peristome weakly twisted, teeth linear.....**POTTIACEAE** (p. 177)
42 Leaf margins plane to erect or rarely weakly inflexed:
44 Capsules long-cylindrical; peristome teeth divided to base, papillose throughout; stem in section with outer cortical cells in 2–3 rows, stereids or strongly incrassate; cells of leaf subula narrowly rectangular to linear or elliptical and strongly incrassate .....**DITRICHACEAE** (p. 83)
44 Capsules short-elliptica *or* cylindrical above well-defined neck; peristome teeth perforated or cleft to near middle, longitudinally striate or barred, papillose above; stem in section with outer cortical cells in 1–2 rows, incrassate; cells of leaf subula generally broader, rectangular to short rectangular or infrequently quadrate..... .....**DICRANACEAE** (p. 105)

28 Laminal cells papillose, mammillose or prorate:
45 Laminal cells prorate:
46 Plants small; leaves oval to oblong, subulate; capsule cylindrical with well-defined neck.....**DICRANACEAE** (p. 105)
46 Plants medium to large; leaves ovate-acuminate to lanceolate, *if* subulate, plants large; capsule globose to short-cylindrical; peristome double.....**BARTRAMIACEAE** (Fascicle 2)
45 Laminal cells mammillose or papillose:
47 Laminal cells mammillose:
48 Laminal cells distinctly mammillose dorsally and ventrally:
49 Plants growing on soil; leaves ligulate, 1–2 mm long, lamina unistratose.....**DICRANACEAE** (p. 105)

49 Plants growing on rock; leaves ovate-acuminate, 4–5 mm long, lamina bistratose.....**PTYCHOMITRIACEAE** (Fascicle 3)

48 Laminal cells mammillose ventrally, flat to ± bulging dorsally:

50 Lamina or margins completely or in part bistratose:

51 Margins bistratose, laminae unistratose; leaves gemmiferous apically; basal leaf cells differentiated as cancellinae.....**CALYMPERACEAE** (p. 161)

51 Lamina bistratose; gemmae, if present, axillary; basal leaf cells not strongly differentiated:

52 Upper lamina bistratose juxtacostally.....**POTTIACEAE** (p. 177)

52 Upper lamina completely bistratose.....**PTYCHOMITRIACEAE** (Fascicle 3)

50 Lamina and margins unistratose:

53 Leaves acuminate above obovate base; apex acute, cucullate; juxtacostal cells weakly papillose dorsally.....**DICRANACEAE** (p. 105)

53 Leaves elliptical to obovate; apex broadly acute to rounded; juxtacostal cells smooth dorsally.....**POTTIACEAE** (p. 177)

47 Laminal cells papillose (see also Orthotrichaceae, Fascicle 3):

54 Papillae massive, crown-shaped, multifid:

55 Leaves bordered by 2–6 rows of elongate, hyaline cells; alar cells distinct.....**DICRANACEAE** (p. 105)

55 Leaves not bordered by elongate, hyaline cells; alar cells not differentiated.....**POTTIACEAE** (p. 177)

54 Papillae smaller, mostly low and blunt or C- to O-shaped, occasionally spinose or bifid:

56 Margins narrowly bordered by elongate, hyaline cells *or* bistratose and generally dentate:

57 Basal leaf cells differentiated as cancellinae.....**CALYMPERACEAE** (p. 161)

57 Basal leaf cells not differentiated as cancellinae:

58 Costa in section with ventral stereid band exposed, ventral surface cells not differentiated.....**DICRANACEAE** (p. 105)

58 Costa in section with differentiated ventral surface cells above ventral stereid band.....**CALYMPERACEAE** (p. 161)

56 Margins not bordered, rarely bistratose:

59 Leaves broad, elliptical to lingulate or spathulate; laminal cells with several C-shaped papillae over lumen:

60 Calyptra very large, cylindrical-rostrate, completely covering capsule; peristome absent or teeth short-lanceolate, fragile; costa ending below apex to mucronate.....**ENCALYPTACEAE** (p. 173)

60 Calyptra smaller, cucullate; peristome teeth divided into 32 filaments above basal membrane; costa apiculate to long excurrent.....**POTTIACEAE** (p. 177)

59 Leaves narrower, mostly broadest below mid-leaf, ovate to lanceolate or ligulate; papillae mostly low and blunt, occasionally spinose or C-shaped; calyptra small, cucullate.....**POTTIACEAE** (p. 177)

SPHAGNACEAE

Plants generally robust, forming large hummocks, pale green to yellow-green or occasionally pinkish to reddish; terricolous or saxicolous, aquatic to semi-aquatic. *Stems* erect, sparsely divided; hyalodermis transparent, internal cylinder brownish, pinkish or greenish; in section central cells of internal cylinder thin-walled, becoming smaller, thickened and coloured toward margin, cells of hyalodermis lax, in 1–4 rows. *Fascicles* of branches spirally arranged around stem, becoming crowded at stem tip; branches monomorphic or dimorphic; internal cylinder frequently coloured or green; in section hyalodermis 1 layer thick. *Leaves* generally differentiated, ecostate; *stem leaves* smaller, distant; triangular to oblong or lingulate; apex acute to rounded, serrulate to lacerate; margin plane to erect, frequently bordered by 1–8 rows of narrow cells; *branch leaves* numerous, frequently crowded; oval or ovate to lanceolate; apex acute to obtuse, serrate to dentate or truncate with numerous teeth; margins erect to incurved above, bordered by 1–3 rows of narrow cells to near apex. *Areolation* of two types: *leucocysts* large, inflated, hyaline cells, generally with numerous fibrils and pores (or pseudopores), although pores and/or fibrils occasionally absent; *chlorocysts* much smaller, green, forming network around leucocysts; in section chlorocysts triangular to trapezoid or oval to rectangular, totally enclosed or exposed on one or both surfaces, leucocysts convex or strongly bulging on one or both surfaces.

Dioicous or monoicous. Perigonia and perichaetia on short lateral branches; perichaetial leaves conspicuous, larger, convolute. *Sporophyte* elevated above perichaetial leaves at maturity by pseudopodia, seta not differentiated; capsule operculate, gymnostomous, globose at maturity, urceolate to oblong-cylindrical after dehiscence; operculum convex; calyptra membranous, hyaline; spores expelled through explosive dehiscence, tetrahedal, relatively large, weakly ornamented.

The family contains just over 200 species in a single genus, *Sphagnum*. The family is economically by far the most important of the mosses. In addition to its ecological importance in bog formation, *Sphagnum* has a great many uses in horticulture, agriculture, medicine and the chemical industry. In areas where *Sphagnum* grows in abundance, it has also been used as a fuel and in the production of charcoal.

SPHAGNUM

Sphagnum *L.*, Sp. Pl. 2: 1106 (1753); Hedw., Spec. Musc. 27 (1801); Warnst., Sphag. Univ. 39 (1911); Sim, Bryo. S. Afr. 129 (1926); Garside in Jl S. Afr. Bot. 15: 59 (1949); Eddy in Bull. Br. Mus. nat. Hist. 5 (7): 371 (1977). Lectotype species: *S. palustre* L., vide Britt. in Britt., Fl. Bermuda 431 (1918).

With characters of the family.

The genus is found throughout the world in association with wet or damp habitats. In Southern Africa, true bogs, in the northern sense, are not formed and *Sphagnum* is confined to shaded mountain seeps, stream banks, small pools or open swampy areas.

1 Branch leaf margin (in section) with resorption furrow ..... 3. *S. strictum* subsp. *pappeanum*

1 Branch leaf margin (in section) without resorption furrow:

2 Stem leaf leucocysts without fibrils:

3 Stem leaf apex very broad, lacerate; with distinct areas of narrower cells on either side of lower leaf ..... 1. *S. fimbriatum*

3 Stem leaf apex acute to obtuse, frequently toothed, not lacerate; lower leaf without areas of narrower cells:

4 Plants pink; chlorocysts in section broadly exposed ventrally ..... 2. *S. obtusiusculum*

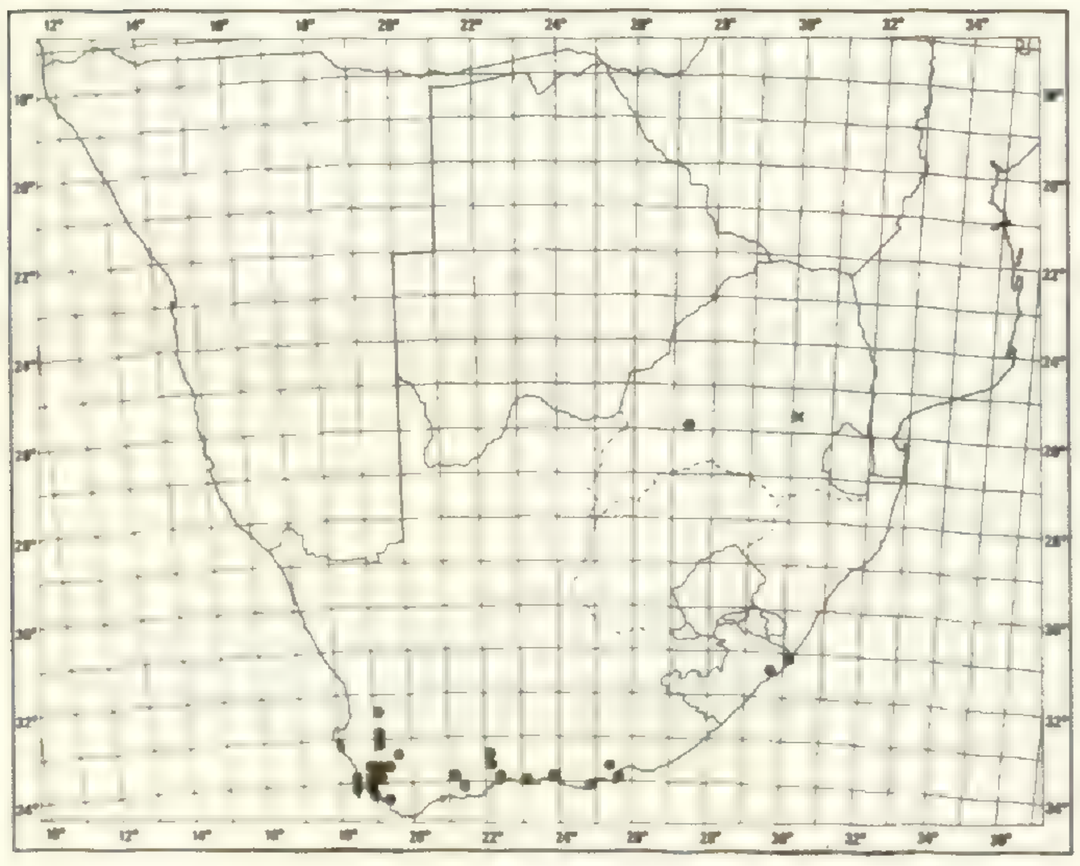
4 Plants pale green; chlorocysts in section totally enclosed or occasionally exposed dorsally ..... 7. *S. pycnocladulum*

2 Stem leaf leucocysts with fibrils, strong or weak:
5 Hyalodermis of branches, (in surface view) fibrillose.....4. *S. perichaetiale*
5 Hyalodermis of branches efibrillose:
6 Stem hyalodermis 1 cell thick or outer cells of internal cylinder not thickened and hyalodermis not well defined:
7 Branch leaves broadly oval, margins generally incurved; stem leaves approaching size of branch leaves; chlorocysts in section equally exposed on dorsal and ventral surfaces.....5. *S. africanum*
7 Branch leaves ovate, margins erect; stem leaves generally smaller; chlorocysts in section with wider exposure on dorsal surface.....6. *S. truncatum*
6 Stem hyalodermis 2–3 cells thick:
8 Pores of branch leaf leucocysts few; plants pink.....2. *S. obtusiusculum*
8 Pores of branch leaf leucocysts numerous; plants greenish:
9 Stem leaf leucocysts efibrillose or fibrils irregular, not well defined.....7. *S. pycnocladulum*
9 Stem leaf leucocysts with regular, well defined fibrils.....8. *S. capense*

1. **Sphagnum fimbriatum** *Wils.* in Hook., Crypt. Bot. Antarct. Voyage 92 (1845); Warnst., Sphag. Univ. 53 (1911); Garside in Jl S. Afr. Bot. 15: 68 (1949); Smith, Moss Fl. Brit. Irel. 44 (1978). Type: Falkland Island, *Hooker* s.n. (BM).

Plants long, slender, pale green; terricolous. *Stems* 80–120 mm long; internal cylinder green to brownish green, hyalodermis efibrillose, pores few; in section inner cells of internal cylinder thin-walled, becoming smaller and thickened toward margin, hyalodermis fragile, 2 cells thick. *Fascicles* of 4–5 dimorphic branches: 2–3 spreading, 1–2 pendent; internal cylinder greenish, hyalodermis efibrillose, pores present on most cells. *Stem leaves* spathulate, 1,0–1,4 mm long; apex entensively resorbed, rounded, lacerate; margins plane, border weak, 2–3 rows of narrow cells restricted to base; lower portion of leaf with obvious region of narrow cells on either side of the midline; leucocysts efibrillose, pores absent, dorsal and ventral surfaces extensively resorbed in upper portion of leaf, frequently leaving only a network of chlorocysts. *Branch leaves* ovate-acuminate, 1,0–1,8 mm long; apex acute, with 1–2 teeth; margins incurved above, border of 2–3 rows of narrow cells reaching upper leaf; leucocysts regularly fibrillose, pores numerous along commissures; in section chlorocysts trapezoid with wider exposure on ventral surface.

Perichaetia lateral; leaves broad, spathulate, concave, apex truncate, lacerate. *Pseudopodia* 5–10 mm long; capsules short-cylindrical, 2 mm long, red-brown; operculum convex; spores 20–25 μm, with distinct tetrad scar, smooth. Fig. 3: 1–9.



MAP 1.— ● **Sphagnum truncatum**
× **Sphagnum fimbriatum**

FIG. 3.—**Sphagnum fimbriatum** (1–9): **1.** habit, ×1; **2.** stem and fascicle, ×5; **3.** stem in cross section, ×120; **4.** branch in cross section, ×150; **5.** stem leaf, ×24; **6.** branch leaf, ×24; **7.** branch leaf in cross section, ×250; **8.** stem leaf areolation, ×435; **9.** branch leaf areolation, ×435. **S. obtusiusculum** (10–18): **10.** habit, ×1; **11.** stem and fascicle, ×5; **12.** stem in cross section, ×130; **13.** stem leaf, ×20; **14.** branch leaf, ×20; **15.** stem leaf in cross section (central part), ×150; **16.** branch leaf in cross section (central part), ×150; **17.** stem leaf areolation, ×435; **18.** branch leaf areolation, ×435. **S. strictum** subsp. **pappeanum** (19–27): **19.** habit, ×1; **20.** stem and fascicle, ×5; **21.** stem in cross section, ×120; **22.** stem leaf, ×20; **23.** branch leaf, ×20; **24.** stem leaf in cross section (central section), ×240; **25.** branch leaf in cross section (at margin), ×240; **26.** stem leaf areolation, ×300; **27.** branch leaf areolation, ×435. (1–9, *Wager* 1525; 10–18, *Wilman* 527; 19–27, *Esterhuysen* 15049).

This widespread species is known from Europe, Asia, North America, Australia, southern South America and Southern Africa. *Sphagnum fimbriatum* is rare in the Flora area, collected only once at Belfast in the eastern Transvaal. Map 1.

Voucher: *Wager* 1057.

Sphagnum fimbriatum was originally reported for Southern Africa (Dixon & Wager, 1930) from George in the Cape. However, Wager's own specimen (PRE) and a specimen sent to the National Herbarium by Wager both indicate that the collecting locality is Belfast, Transvaal. If the Transvaal location is correct it is possible that the species was introduced from Europe during trout introduction in the streams of that area.

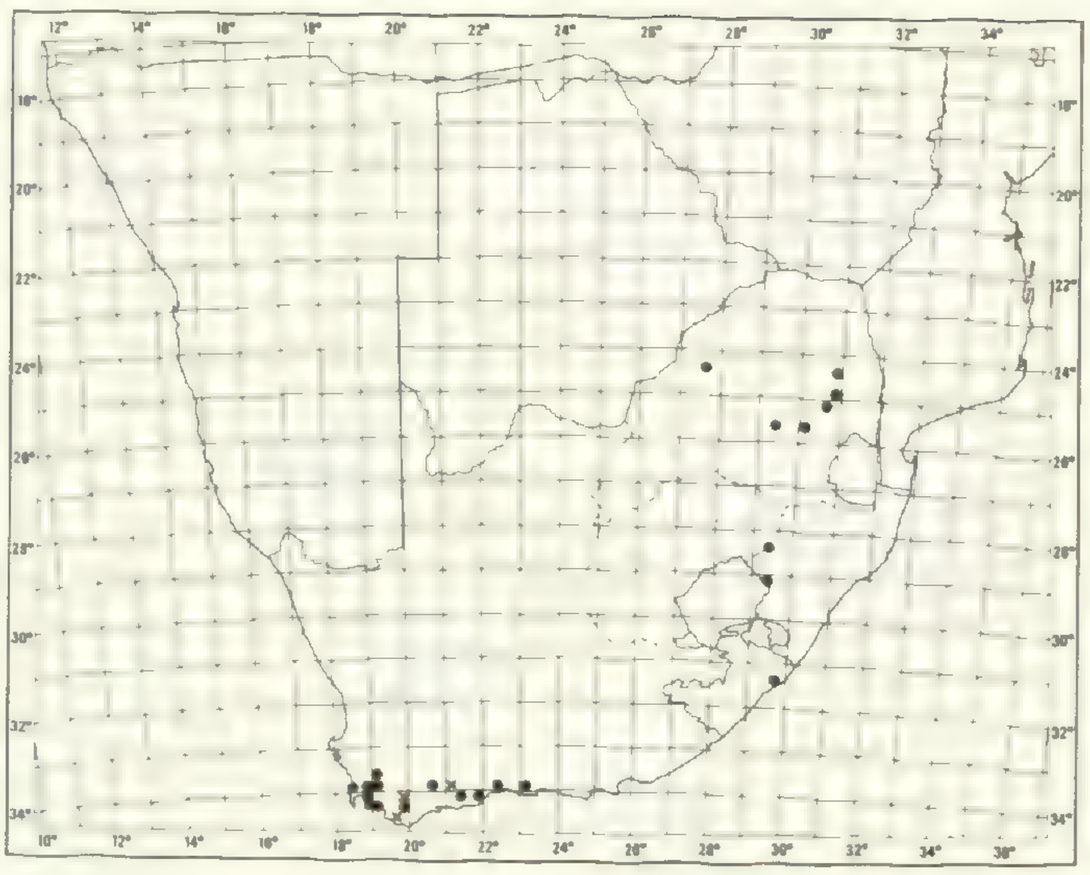
2. **Sphagnum obtusiusculum** *Lindb.* ex *Warnst.* in Hedwigia 29: 196 (1890); Warnst., Sphag. Univ. 90 (1911). Syntypes: Madagascar, *Pollen & Van Dam* s.n.; *Besson* s.n.; Rèunion, *Richards* 683; *Rodriguez* s.n.; *Chauvel* s.n.; Mauritius, s. coll. in herb. Renauld & Cardot.

Sphagnum laceratum sensu Garside in Jl S. Afr. Bot. 15: 71 (1949), non C. Müll. & Warnst. (1897).

Plants medium to large, pink, becoming yellowish with age, brownish below; terricolous. *Stems* to 60 mm high; internal cylinder pink, hyalodermis efibrillose, pores scattered; in section inner cells of internal cylinder large, outer 3–4 rows smaller, strongly incrassate, hyalodermis 2–3 cells thick. *Fascicles* of 3–4 monomorphic spreading branches; internal cylinder pink, hyalodermis efibrillose, pores 1–2 per cell. *Stem leaves* oblong, 1,0–1,6 mm long; apex obtuse to rounded, serrate; margins erect, border of 4–6 rows of narrow cells extending to mid-leaf; leucocysts efibrillose or occasionally very weakly fibrillose in upper leaf, pores rare, some cells with single pore; in section chlorocysts rectangular to triangular with wider exposure on ventral surface, leucocysts bulging dorsally. *Branch leaves* ovate-acuminate, 1,2–1,6 mm long; apex acute, with 1–2 teeth; margins incurved above, border of 2–3 rows of narrow cells extending to near apex; leucocysts regularly fibrillose, pores few, 1–3 per cell; in section chlorocysts triangular to trapezoid with wider exposure on ventral surface, leucocysts bulging dorsally.

Sporophyte not known. Fig. 3: 10–18.

Sphagnum obtusiusculum is found on Madagascar, Réunion and Mauritius. In Southern Africa the species is infrequently collected on damp soil or rock in the southern and southwestern Cape. Map 2.



MAP 2.— ● **Sphagnum capense**
× **Sphagnum obtusiusculum**

Vouchers: *Brenan* M2783; *Esterhuysen* 26974; *Muir* PRE-CH4138.

The most striking character of *S. obtusiusculum* is its vivid pink colour. Several of the Southern African species are tinged or partly coloured with red or purple hues, but in *S. obtusiusculum* the exposed parts of the plants are markedly coloured throughout; the lower parts of the stem are brownish.

3. **Sphagnum strictum** *Sull.* subsp. **pappeanum** (*C. Müll.*) *Eddy* in Bull. Br. Mus. nat. Hist. 5 (7): 433 (1977). Type: Cape, Swellendam, *Pappe* s.n., 1838.

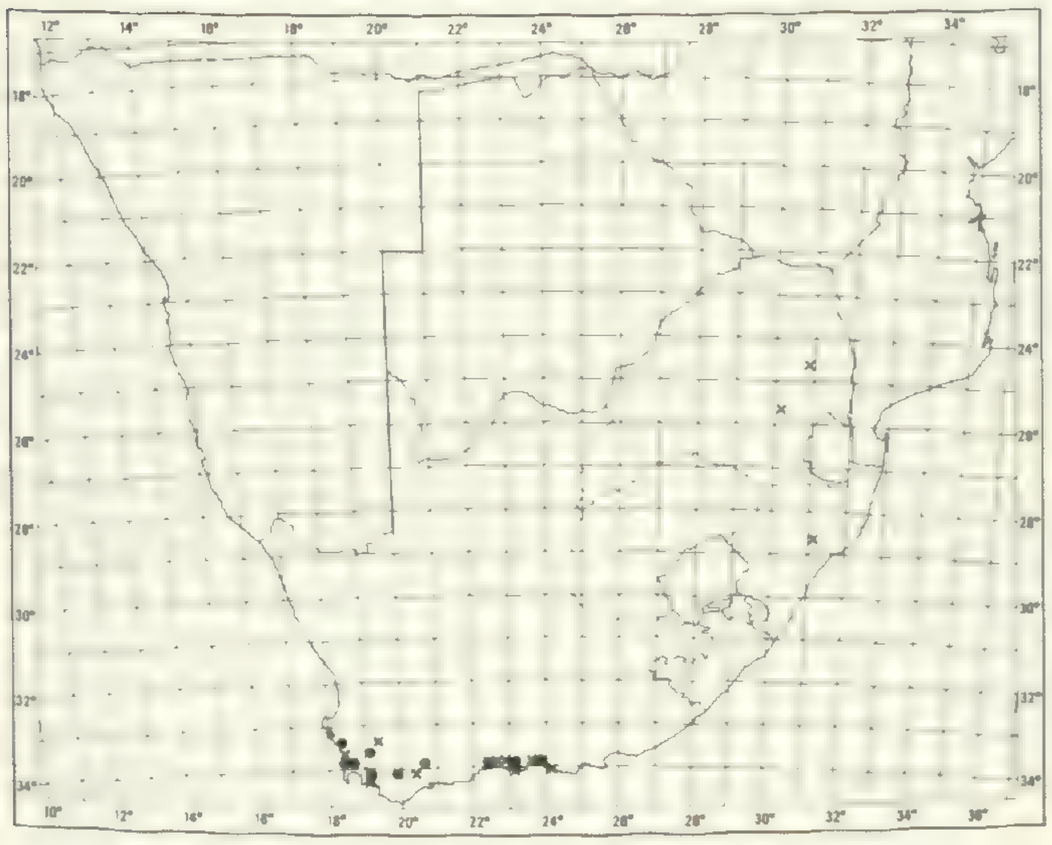
Sphagnum pappeanum C. Müll., Syn. Musc. 1: 101 (1848); Warnst., Sphag. Univ. 151 (1911); Sim, Bryo. S. Afr. 131 (1926); Garside in Jl S. Afr. Bot. 15: 71 (1949).

Plants large to robust, pale yellow to yellow-green, occasionally reddish, brownish below; terricolous. *Stem* 60–180 mm long; internal cylinder green to yellow-brown, hyalodermis efibrillose, pores ± 1 per cell; in section cells of internal cylinder weakly thickened, smaller toward margins, hyalodermis 2–3 cells thick. *Fascicles* of 5(6) dimorphic branches: 2–3 spreading, 2–3 pendent; internal cylinder green to yellowish, hyalodermis efibrillose, ±1 pore per cell. *Stem leaves* triangular, 0,8–1,0 mm long; apex obtuse, erose-denticulate; margins erect, border indistinct, 6–8 cells wide below; leucocysts efibrillose or occasionally some cells weakly fibrillose at apex, pores few, frequently with resorption gaps; in section chlorocysts oval, enclosed or just exposed on dorsal surface,

leucocysts weakly convex on both surfaces. *Branch leaves* ovate to oval, acuminate, 2,5–3,0 mm long; apex truncate, dentate; margins erect to incurved above, border of single row of narrow cells extending to apex, in section with resorption furrow; leucocysts regularly fibrillose, pores scattered along commissures; in section chlorocysts narrowly oval, enclosed or just exposed dorsally, commissure wall papillose, leucocysts convex on both surfaces.

Perichaetia on short lateral branch near apex; leaves oval, 4 mm long, convolute, apex rounded, serrate. *Pseudopodia* to 8 mm long; capsules oval, 1,5 mm long, red-brown; operculum and calyptra not seen; spores bulging triangular, 35μm, coarsely granulate. Fig. 3: 19–27.

Sphagnum strictum subsp. *pappeanum* occurs in Central America and the West Indies, eastern and Southern Africa, the East African Islands, Celebes and New Guinea. In Southern Africa, the subspecies has been collected in the southern and southwestern Cape, Natal and the eastern Transvaal. Map 3.



MAP 3.— ● **Sphagnum pycnocladulum**
× **Sphagnum pappeanum**

Vouchers: *Cholnoky* 843; *Magill* 6070; *Van der Schijff* 4521; *Taylor* 1136b.

This taxon is identified by its multi-layered hyalodermis, large oval-acuminate branch leaves and the resorption furrow along the margins of the branch leaves. The subspecies *pappeanum* differs from the typical subspecies, which occurs in North America and Europe, by its larger leaves, enclosed, oval chlorocysts, and coarser papillation of the commissure walls (cf. Eddy, 1977).

4. **Sphagnum perichaetiale** *Hampe* in Linnaea 20: 66 (1847); Warnst., Sphag. Univ. 486 (1911); Eddy in Bull. Br. Mus. nat. Hist. 5(7): 380 (1977). Type: Brazil (BM, holo.).

Sphagnum balfourianum Warnst. in Hedwigia 30: 153 (1891); Warnst., Sphag. Univ. 470 (1911); Garside in Jl S. Afr. Bot. 15: 67 (1949), fide Eddy (1977). Syntypes: Mauritius, *Balfour* s.n. (NY); Cape, *Rehmann* s.n. (H-BR!).

Sphagnum marlothii Warnst. in Sphag. Univ. 471 (1911); Garside in Jl S. Afr. Bot. 15: 68 (1949), fide Eddy (1977). Type: Cape, Table Mountain, *Marloth* s.n.

Plants large to robust, pale green, occasionally slightly pinkish, brownish below; terricolous or saxicolous. *Stems* 80–140 mm high; internal cylinder red-brown, hyalodermis efibrillose to weakly fibrillose, pores ±1 per cell; in section cells of internal cylinder thickened, outer 3–4 rows much smaller, strongly thickened, hyalodermis in 3 layers. *Fascicles* of 3–4 dimorphic branches: 2–3 spreading, 1–2 pendent; internal cylinder red-brown, hyalodermis fibrillose, pores scattered or 1 per cell. *Stem leaves* variable in shape; broadly elliptical to weakly obovate, 1,2–2,0 mm long; apex rounded, serrate or weakly notched; margins unbordered; leucocysts regularly fibrillose above base, occasionally weakly so, pores few, irregularly placed along commissures; in section chlorocysts oval to trapezoid with wider exposure on ventral surface, leucocysts mostly flattened ventrally, strongly bulging dorsally. *Branch leaves* broad, ovate to oval, 2,0–2,8 mm long; apex obtuse, cucullate; margins entire, erect, unbordered; leucocysts strongly fibrillose throughout, pores few, scattered along commissures; in section chlorocysts triangular to trapezoid or oval with wider exposure on ventral surface, leucocysts flattened ventrally, strongly bulging dorsally.

Sporophytes not known from Southern Africa. Fig. 4: 1–12.

This widespread species is known from North and Central America, northern South America, Africa south of the equator, East African Islands, southern Asia, and Australia. In Southern Africa *S. perichaetiale* is found in the southwestern and southern Cape and southern Natal. Map 4.

Voucher: *Esterhuysen* 15839.

In addition to the robust plants and large ovate branch leaves, the presence of fibrils in the hyalodermis of branches and occasionally stems, will help to place specimens of *S. perichaetiale*.

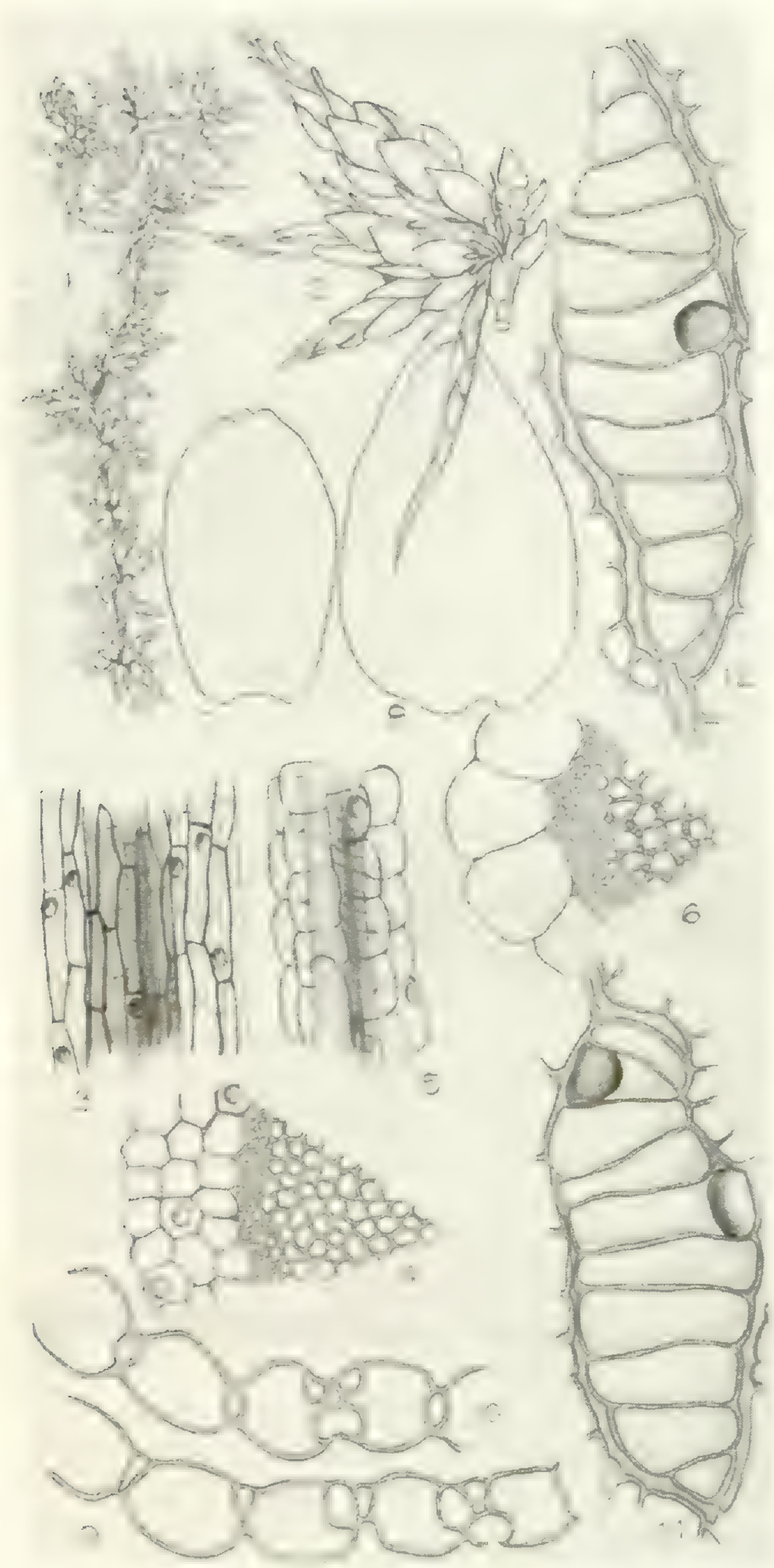


FIG. 4.—**Sphagnum perichaetiale: 1.** habit, ×1; **2.** stem and fascicle, ×5; **3.** stem in surface view, ×25; **4.** stem in cross section, ×80; **5.** branch in surface view, ×50; **6.** branch in cross section, ×170; **7.** stem leaf, ×15; **8.** branch leaf, ×15; **9.** stem leaf in cross section (central part), ×220; **10.** branch leaf cross section (central part), ×220; **11.** stem leaf leucocyst, ×435; **12.** branch leaf leucocyst, ×435. (1–12, *Esterhuysen* 15839).

5. **Sphagnum africanum** *Welw. & Dub.* in Mém. Soc. Phys. Hist. nat. Genève 21: 216 (1870); Warnst., Sphag. Univ. 421 (1911). Type: Angola, Huilla, *Welwitsch* 77 (G!).

Sphagnum oligodon C. Müll. in Flora, Jena 70: 412 (1887); Warnst., Sphag. Univ. 363 (1911). Type: Natal, Inanda, *Rehmann* 14 (PRE!).

Sphagnum rehmannii Warnst. in Hedwigia 30: 16 (1891); Warnst., Sphag. Univ. 372 (1911); Sim, Bryo. S. Afr. 132 (1926). Syntypes: Natal, *Rehmann* s.n.; *Gueinzius* s.n. (NY); Transvaal, *MacLea* s.n. (*Rehmann* 431, PRE!).

Sphagnum transvaaliense Warnst. in Hedwigia 30: 32 (1891). Type: Transvaal, Spitzkop to Lydenburg, *Wilms* s.n. (G!).

Sphagnum oligodon var. *bachmannii* Warnst., Sphag. Univ. 363 (1911). Type: Transkei, Pondoland, *Bachmann* 5 (H-BR).

Sphagnum oligodon var. *beyrichii* Warnst., Sphag. Univ. 364 (1911). Type: Transkei, Pondoland, *Beyrich* 25 (H-BR).

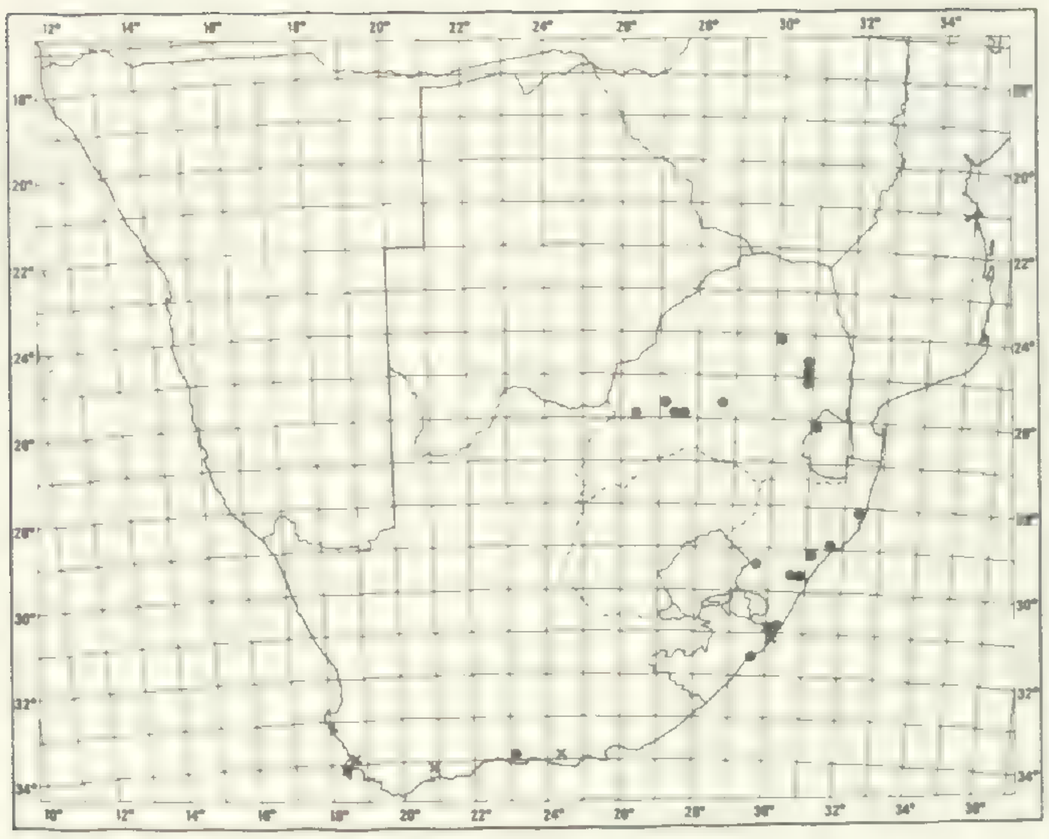
Plants medium to large (robust), pale green to yellow-green, brownish below; saxicolous or terricolous. *Stems* 35–120 mm high; internal cylinder green, hyalodermis efibrillose, pores few; in section cells of internal cylinder not thickened or only weakly so, hyalodermis 1 cell thick. *Fascicles* of 3–4 dimorphic branches: 2–3 spreading, 1–2 pendent; internal cylinder greenish, hyalodermis efibrillose, pores weakly defined. *Stem leaves* broad, ovate to oblong, 2,4–2,7 mm long; apex obtuse, serrulate; margins erect, border of 2–4 rows of narrow cells extending to near apex; leucocysts regularly fibrillose, pores numerous, regularly placed along commissure, in section chlorocysts rectangular to oval, equally exposed on both surfaces, leucocysts weakly bulging on both surfaces. *Branch leaves* broad, oval or occasionally ovate, 1,8–2,8 mm long; apex rounded, serrate; margins incurved above, border of 1–2 rows of narrow cells to near apex; leucocysts regularly fibrillose, pores numerous along commissures; in section chlorocysts rectangular to oval, exposure equal, cells very thin-walled, leucocysts weakly bulging on both surfaces.

Sporophyte not known. Fig. 5: 19–27.

The species was described from Angola and has recently been discovered in Southern Africa. In the Flora area the species is found in streams, pools or very wet areas of the western, central and eastern Transvaal, Swaziland, Zululand, Natal, Transkei and southern Cape. Map 4.

Vouchers: *Arnold* 1238; *Cholnoky* 259, 876; *Hilliard & Burtt* 11793; *Magill* 5271; *Rankin* 120; *Smook* 859; *Van Rooy* 170; *Venter* 2999; *Von Breitenbach* 54.

Sphagnum africanum is identified by its single-layered hyalodermis, large stem leaves, broadly oval branch leaves with rounded, serrate apices and chlorocyst in section being rectangular and equally exposed on both surfaces. The species is very closely



MAP 4.— ● **Sphagnum africanum**
× **Sphagnum perichaetiale**

related to *S. truncatum* and the two species occasionally prove difficult to separate. Differences in branch leaf shape, development of branch leaf apices, chlorocyst shape and exposure in section, and to a lesser degree distribution will generally separate specimens.

6. **Sphagnum truncatum** *Hornsch.* in Linnaea 15: 114 (1841); Warnst., Sphag. Univ. 386 (1911); Sim, Bryo. S. Afr. 132 (1926); Garside in Jl S. Afr. Bot. 15: 72 (1949). Type: Cape, Du Toit's Kloof Mountains, *Drège* s.n. (G!).

Sphagnum coronatum C. Müll. in Flora, Jena 70: 412 (1887); Warnst., Sphag. Univ. 306 (1911); Sim, Bryo. S. Afr. 132 (1926). Type: Cape, Montagu Pass, *Rehmann* 9 (PRE!).

?*Sphagnum fluctuans* C. Müll. in Flora, Jena 70: 414 (1887). Type: Cape, Gnadenthal, *Breutel* s.n.; vide Warnst., Sphag. Univ. 309 (1911).

Sphagnum convolutum Warnst. in Hedwigia 29: 217 (1890). *Sphagnum marginatum* var. *convolutum* Warnst., Sphag. Univ. 309 (1911). Syntypes: Cape, Table Mountain, *MacOwan* s.n., 1886; Simonstown, *Wright* s.n. (FH).

Sphagnum marginatum Warnst. in Hedwigia 30: 28 (1891). Type: Cape, Sonderend, *Breutel* s.n. (BM; PC).

Sphagnum coronatum var. *cuspidatum* Warnst., Sphag. Univ. 306 (1911). Type: Cape, Worcester, *Rehmann* 10, p.p.

Sphagnum marginatum var. *diversifolium* Warnst., Sphag. Univ. 310 (1911). Type: Cape, Sonderend, *Breutel* s.n. (PC).

Sphagnum oxycladum Warnst. in Hedwigia 30: 15 (1891); Warnst., Sphag. Univ. 306 (1911). Type: Cape, Worcester, *Rehmann* 10, p.p.

Plants medium to large, pale green to yellow-green, occasionally reddish, brown below; terricolous or saxicolous. *Stems* 35–110 mm high; internal cylinder brownish to green, hyalodermis efibrillose, pores weakly defined, ± 1 per cell; in section inner cells large, thin-walled, outer cells smaller, frequently incrassate, coloured, occasionally only weakly thickened, hyalodermis 1 cell thick. *Fascicles* of 4–5 dimorphic branches: 2–3 spreading, 1–2 pendent; internal cylinder brownish, hyalodermis efibrillose, pores weakly defined. *Stem leaves* oblong, 1,8–2,0 mm long; apex obtuse; margins plane, border of 2–4 rows of narrow cells extending to near apex; leucocysts regularly fibrillose, pores few, scattered along commissures; in section chlorocysts trapezoid with wider exposure on dorsal surface, rarely elliptical, equally exposed, leucocysts bulging ventrally or occasionally weakly bulging on both surfaces. *Branch leaves* broadly lanceolate to ovate-acuminate, 2,0–4,2 mm long; apex truncate, toothed; margins erect, border of 1–2 rows of narrow cells extending to upper leaf; leucocysts regularly fibrillose, pores few, scattered along commissures; in section chlorocysts trapezoid with wider exposure on dorsal surface, leucocysts bulging ventrally.

Sporophyte not known. Fig. 5: 1–9.

Endemic to Southern Africa, *S. truncatum* is most common in the southwestern and southern Cape. A few specimens have also been collected in pools in the Transkei and in central Transvaal. Map 1.

Vouchers: *Cholnoky* 302, 1077; *Emdon* 4; *Schelpe* 7838; *Stokoe* 9490.

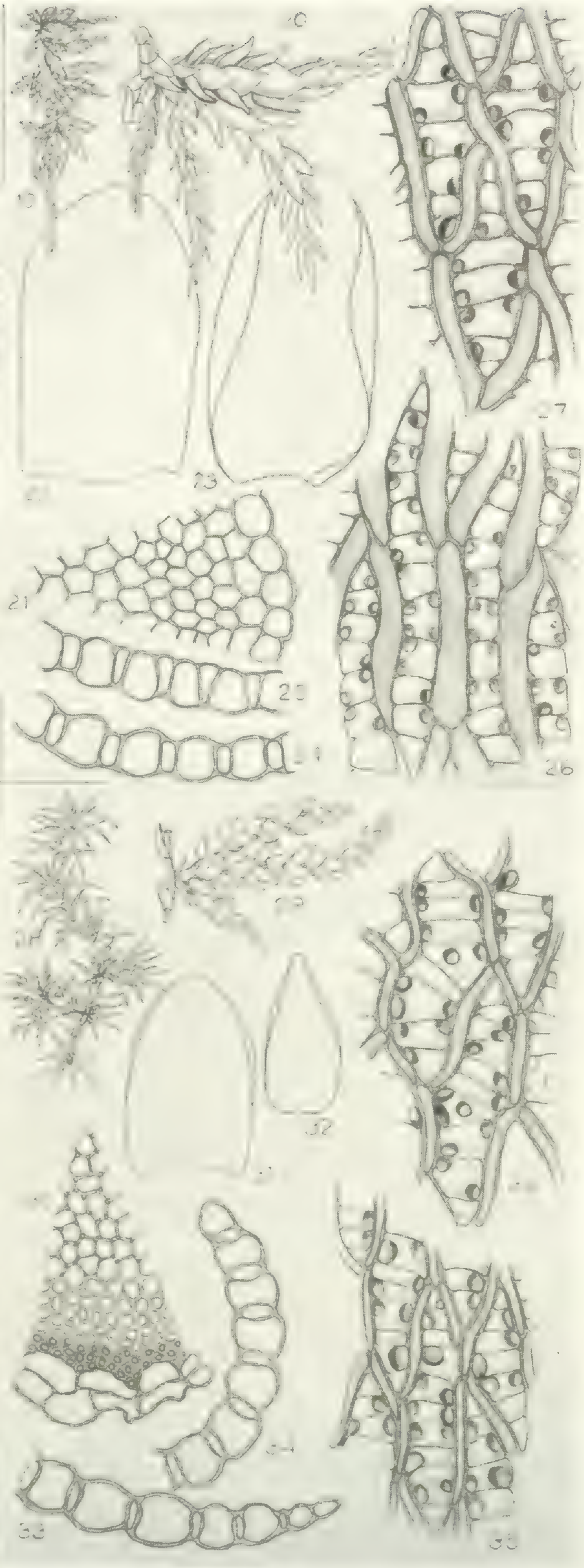
The single-layered hyalodermis, large lanceolate branch leaves and chlorocysts trapezoid in section, will identify *S. truncatum*. This species is similar to *S. africanum*; for differences see note under that species.

Variation in *S. truncatum* is expressed in the size and shape of branch leaves, shape of chlorocysts in section and degree of thickening of the outer cell in the internal cylinder of the stem.

7. **Sphagnum pycnocladulum** *C. Müll.* in Flora, Jena 70: 420 (1887); Warnst., Sphag. Univ. 174 (1911); Sim, Bryo. S. Afr. 131 (1926). Type: Cape, Montagu Pass, *Rehmann* s.n., 1875.

Sphagnum pycnocladulum var. *fuscescens* Warnst., Sphag. Univ. 176 (1911). Type: Cape, Montagu Pass, *Rehmann* 13 (NH; PRE!).

Sphagnum pycnocladulum var. *viride* Warnst., Sphag. Univ. 176 (1911). Type: Cape, Montagu Pass, *Rehmann* 17 (PRE!).



Plants medium to large, yellow-green to yellowish, occasionally reddish, brown below; terricolous or saxicolous. *Stems* 50–120 mm high; internal cylinder brownish, hyalodermis efibrillose, pores weakly defined, ±1 per cell; in section inner cells large, thin-walled, becoming smaller and incrassate toward margin of internal cylinder, hyalodermis 2–3 cells thick. *Fascicles* of 5–6 monomorphic branches; internal cylinder brownish, hyalodermis efibrillose, pores scattered to 1 per cell. *Stem leaves* broad, oblong to spathulate, 0,9–1,2 mm long; apex obtuse; margins plane, bordered by 2–4 rows of narrow cells to near apex; leucocysts essentially efibrillose, pores large, numerous, confined to commissures, absent in leaf base; in section chlorocysts oval, totally enclosed or occasionally equally exposed on both surfaces; leucocysts slightly bulging on both surfaces. *Branch leaves* ovate, 0,6–0,8 mm long; apex acute; margins involute above, border of narrow cells 1–2 cells wide, extending to near apex; leucocysts fibrillose, although frequently weakly so, occasionally efibrillose, pores numerous along commissures; in section chlorocysts oval, totally enclosed or sometimes equally exposed on both surfaces, leucocysts slightly bulging dorsally.

Perichaetia terminal; leaves broadly oval, 2,7 mm long; apex broadly acute, somewhat irregular; leucocysts fibrillose to efibrillose. *Pseudopodia* 4,5–5,0 mm long; capsule exserted, dark red-brown, mouth widespreading when deoperculate; operculum and calyptra not seen; spores bulging triangular, 35 μm, tetrad scar obvious, finely granulose. Fig. 5: 10–18.

In Southern Africa the species is presently only known from the Cape Province but it has also been reported from Ruwenzori and Usambara in eastern Africa. Map 3.

Vouchers: *Cholnoky* 305; *Esterhuysen* 27350; *Garside* 6293; *Magill* 6297.

Sphagnum pycnocladulum is in many ways very similar to *S. capense*. Differences are most obvious in the number of branches in the fascicles, leaf size and, to a lesser degree, shape and the development of fibrils in leaf leucocysts. The stem leaf fibrils in *S. capense* are regular and well developed, while in *S. pycnocladulum* the stem leaf leucocysts are practically efibrillose. In addition the branch leaf fibrils of the latter are generally not as regular or as well developed.

The two species also have different distribution areas. Southern African collections of *S. pycnocladulum* are presently known only from the southern and southwestern Cape. *Sphagnum capense* is found in practically the same areas and is also known from Transkei, Natal and eastern Transvaal. Outside Southern Africa, *S. pycnocladulum* occurs throughout eastern Africa, while *S. capense* is found on the East African Islands. Considering the variability expressed by both species in Southern Africa, *S. pycnocladulum* is only provisionally maintained at the species level.

8. **Sphagnum capense** *Hornsch.* in Linnaea 15: 113 (1841); Warnst., Sphag. Univ. 427 (1911); Sim, Bryo. S. Afr. 130 (1926); Garside, p.p. in Jl S. Afr. Bot. 15: 75 (1949); Eddy in Syst. Ass., sp. vol. 14: 109–121 (1979). Syntypes: Cape, Table Mountain, *Ecklon* s.n.; Devil's Kloof, *Drège* s.n.

Sphagnum austromolle C. Müll. in Flora, Jena 70: 419 (1887). *Sphagnum capense* var. *austromolle* (C. Müll.) Warnst., Sphag. Univ. 430 (1911). Syntypes: Cape, Table Mountain, *Rehmann* s.n., Nov. 1875; Devil's Peak, *Rehmann* s.n., Oct. 1876; Montagu Pass, *Rehmann* s.n.

Sphagnum mollissimum C. Müll. in Flora, Jena 70: 418 (1887). *Sphagnum capense* var. *mollissimum* (C. Müll.) Warnst., Sphag. Univ. 430 (1911). Syntypes: Cape, Table Mountain, *Rehmann* s.n., 1875; *Spielhaus* s.n., 1877; Montagu Pass, *Rehmann* s.n.; Stinkwater, *Rehmann* s.n.

Sphagnum panduraefolium C. Müll. in Flora, Jena 70: 418 (1887); Warnst., Sphag. Univ. 299 (1911); Sim, Bryo. S. Afr. 131 (1926); Garside in Jl S. Afr. Bot. 15: 74 (1949). Syntypes: Cape, Table Mountain, *Rehmann* s.n., 1875; Stinkwater, *Rehmann* 16 (BOL!; PRE!).

FIG. 5.—**Sphagnum truncatum** (1–9): **1.** habit, ×1; **2.** stem and fascicle, ×5; **3.** stem in cross section, ×100; **4.** stem leaf, ×20; **5.** branch leaf, ×20; **6.** stem leaf in cross section (central part), ×220; **7.** branch leaf cross section (central part), ×220; **8.** stem leaf areolation, ×435; **9.** branch leaf areolation, ×435. **S. pycnocladulum** (10–18): **10.** habit, ×1; **11.** stem and fascicle, ×5; **12.** stem in cross section, ×125; **13.** stem leaf, ×20; **14.** branch leaf, ×20; **15.** stem leaf in cross section (central part), ×220; **16.** branch leaf in cross section (at margin), ×220; **17.** stem leaf areolation, ×435; **18.** branch leaf areolation, ×435. **S. africanum** (19–27): **19.** habit, ×1; **20.** stem and fascicle, ×5; **21.** stem in cross section, ×100; **22.** stem leaf, ×20; **23.** branch leaf, ×20; **24.** stem leaf in cross section (central part), ×220; **25.** branch leaf in cross section (central part), ×220; **26.** stem leaf areolation, ×435; **27.** branch leaf areolation, ×435. **S. capense** (28–36): **28.** habit, ×1; **29.** stem and fascicle, ×5; **30.** stem in cross section, ×190; **31.** stem leaf, ×20; **32.** branch leaf, ×20; **33.** stem leaf in cross section (at margin), ×220; **34.** branch leaf in cross section (at margin), ×220; **35.** stem leaf areolation, ×435; **36.** branch leaf areolation, ×435. (1–9, *Levyns* 24066; 10–18, *Esterhuysen* 15427; 19–27, *Vorster* 509; 28–36, *Esterhuysen* 15431).

Sphagnum capense var. *multiporosum* Warnst., Sphag. Univ. 428 (1911). Syntypes: Cape, Cape Town, *Ecklon* s.n., 1827; *Ecklon & Zeyher* s.n., 1863; *Rehmann* 16c, 433 (PRE!), 434b (PRE!); *Wilms* 2629; *Laux* s.n.; *Marloth* s.n., 1902; Devil's Peak, *Rehmann* s.n.

Sphagnum beyrichianum Warnst., Sphag. Univ. 385 (1911). Type: Transkei, Pondoland, *Beyrich* s.n. (H-BR).

Plants medium to large, yellow-green to light green, occasionally reddish, brownish below; terricolous or saxicolous. *Stems* 40–110(–220) mm high; internal cylinder brownish, hyalodermis efibrillose, pores weakly defined, ±1 per cell; in section inner cells large, thin-walled, becoming smaller, incrassate toward margin of internal cylinder, hyalodermis 2–3 cells thick. *Fascicles* of 3–4 dimorphic branches: 2–3 spreading, 1 pendent; internal cylinder brownish, hyalodermis efibrillose, pores ±1 per cell. *Stem leaves* broad, oval to oblong, rarely obovate, 1,0–1,7 mm long; apex rounded to acute; margins plane to erect above, border of 1–2 rows of narrow cells extending to near apex; leucocysts regularly fibrillose, pores numerous along commissures, occasionally with free pores; in section chlorocysts oval, enclosed, leucocysts weakly bulging on both surfaces. *Branch leaves* ovate, 0,8–1,2 mm long; apex acute; margins incurved above, border of 1–2 rows of narrow cells extending to apex; leucocysts regularly fibrillose, pores numerous on commissures, occasionally pores few, frequently with free pores; in section chlorocysts oval, enclosed, leucocysts weakly bulging on both surfaces.

Sporophytes not seen. Fig. 5: 28–36.

Sphagnum capense is infrequently collected on wet soil or rock in mountains of the southern and southwestern Cape, Transkei, Natal and eastern and central Transvaal. The species has also been collected in Madagascar and Réunion. Map 2.

Vouchers: *Cholnoky* 1100; *Esterhuysen* 15431; *Kluge* 1053; *Magill* 6316; *Vorster* 461a.

This relatively small-leaved species is clearly distinct from all other Southern African species except *S. pycnocladulum;* see note on differences under that species.

Variation in the Southern African specimens of *S. capense* is most obvious in leucocyst ornamentation. The pores of the leucocysts are generally numerous, occurring all along the commissure and are also frequently free on the surface; however, specimens have been seen with only a few, scattered pores per cell. The fibrils of the leucocysts are typically regular and well developed. Careful examination of leaves of a few specimens, however, reveal some cells with weak or irregular fibrils among the more typical cells.

ANDREAEACEAE

Plants small to large, forming patches or cushions, red-brown to green-black; saxicolous, rarely semi-aquatic. *Stems* slender, generally erect; in section central strand absent, cortical cells weakly incrassate. *Leaves* appressed dry, spreading to squarrose wet; ovate to elliptical, occasionally constricted above base; apex obtuse to subulate. *Costa* present or absent; in section cells not strongly differentiated. *Laminal cells* small, quadrate to rectangular, incrassate, dorsal surface occasionally papillose.

Monoicous or dioicous. *Perigonia* on short lateral branches, gemmate. *Perichaetia* terminal; leaves larger, convolute. *Seta* absent, sporophyte elevated at maturity by pseudopodia; capsule elliptical to ovate-oblong, lacking peristome and operculum, dehiscing through 4–8 longitudinal valves; spores round, yellowish.

The family contains a single genus, *Andreaea*, with c. 100 species.

ANDREAEA

Andreaea *Hedw.*, Spec. Musc. 47 (1801); Broth. in Natürl. PflFam. 10: 129 (1924); Sim, Bryo. S. Afr. 133 (1926); Grout, Moss. Fl. N. Amer. 1: 1 (1936); Sainsb., N. Zeal. Moss. 18 (1955); Schultze-Motel in Willdenowia 6: 25 (1970); Smith, Moss Fl. Brit. Irel. 79 (1978). Type species: *A. rupestris* Hedw.; vide Britt. & Emer. in N. Amer. Fl. 15: 35 (1913).

With characters of the family.

Andreaea forms blackish or reddish patches on bare rock at high altitudes throughout the world. In Southern Africa, *Andreaea* is found on granite near the summits of the higher mountains of the Cape, Lesotho, Natal and the Orange Free State. One exception is the presence of two of the species on Table Mountain.

When fruiting the genus is unmistakable. The capsules are without operculum or peristome; dehiscence occurs through the splitting of the capsule along 4–8 longitudinal valves.

1 Leaves costate:
  2 Plants large; leaves broadly oval to ovate; costa broad below, not reaching upper leaf ..... 2. *A. nitida*
  2 Plants small; leaves narrowly ovate-subulate; costa filling subula ..... 1. *A. subulata*
1 Leaves ecostate:
  3 Leaves unistratose ..... 3. *A. rupestris*
  3 Leaves bistratose ..... 4. *A. bistratosa*

1. **Andreaea subulata** *Harv. ex Hook.* in Hooker's Icon. Pl. 3: 201 (1840); Broth. in Natürl. PflFam. 10: 130 (1924); Sim, Bryo. S. Afr. 134 (1926); Schultze-Motel in Willdenowia 6: 77 (1970); De Sloover in Bull. Jard. bot. nat. Belg. 47: 156 (1977). Type: Cape, Table Mountain, The Port, *Harvey* s.n., 21 Mar. 1837 (BM, holo.!).

Plants medium-sized, loosely caespitose, brown-green to black-green or red-brown; saxicolous. *Stems* 10–20 mm long, irregularly branched; in section round, central strand absent, inner cortical cells in 3 rows, slightly thickened, outer cortical cells in 3 rows, smaller, incrassate. *Leaves* falcate-secund to almost circinate wet or dry; oval to oblong, long-subulate, 2,0–2,5(–3,0) mm long; margins plane, entire. *Costa* wide, filling subula; in proximal section flattened, cells in 2 rows, undifferentiated, strongly thickened; lamina unistratose; in distal section reniform, internal cells in 2–4, rows, small strongly thickened, dorsal and ventral surface cells thin-walled; lamina bistratose. *Upper laminal cells* rounded-quadrate, incrassate, bulging dorsally, smooth ventrally; basal juxtacostal cells rectangular.

Perichaetia terminal; leaves sheathing, convolute, oval, short-acuminate to acute, 3,0–3,5 mm long. *Pseudopodia* light green, 2 mm long; capsules immersed to emergent, elliptical-apiculate, 1,0–1,2 mm long, red-

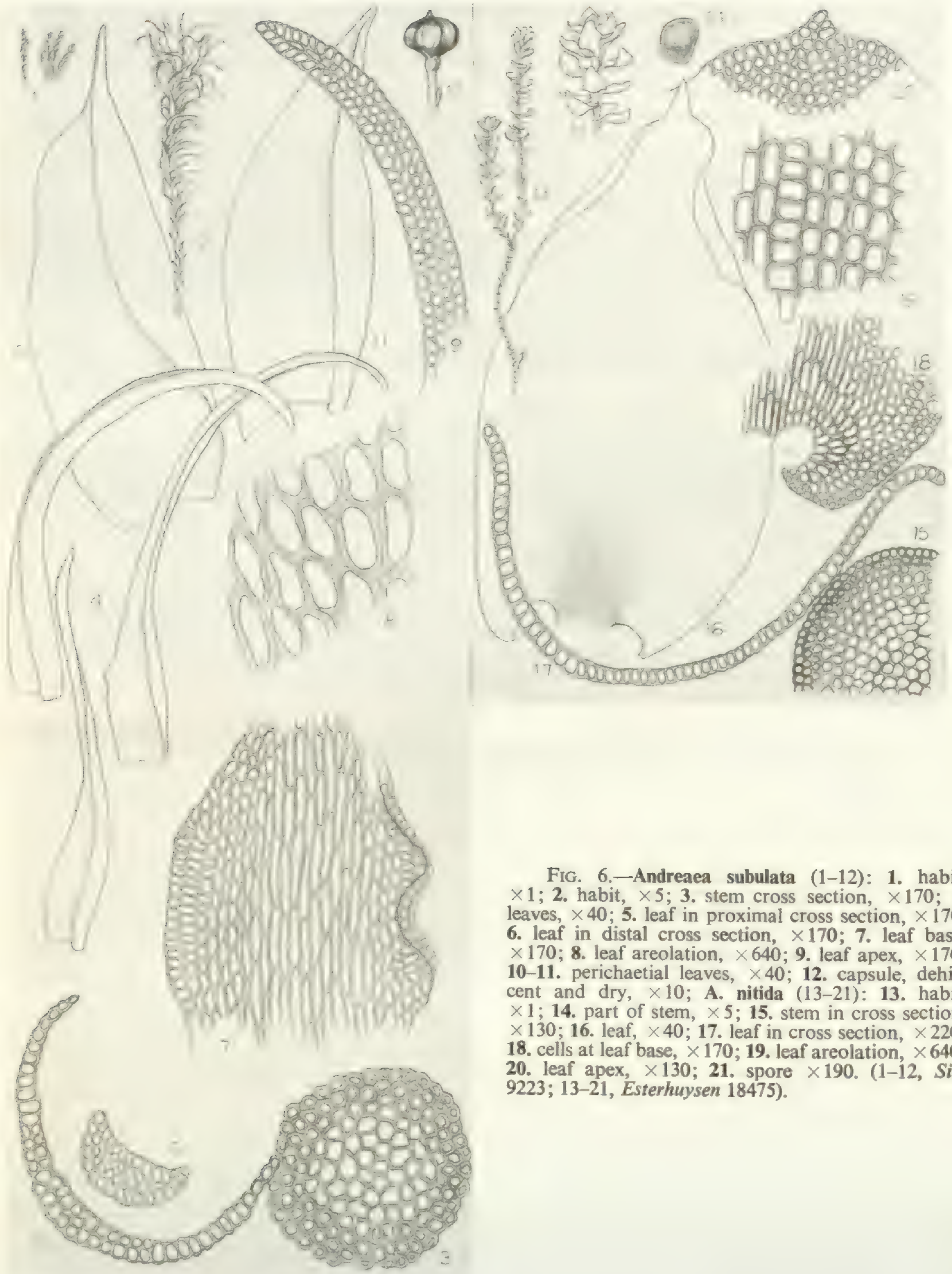


FIG. 6.—**Andreaea subulata** (1–12): **1.** habit, ×1; **2.** habit, ×5; **3.** stem cross section, ×170; **4.** leaves, ×40; **5.** leaf in proximal cross section, ×170; **6.** leaf in distal cross section, ×170; **7.** leaf base, ×170; **8.** leaf areolation, ×640; **9.** leaf apex, ×170; **10–11.** perichaetial leaves, ×40; **12.** capsule, dehiscent and dry, ×10; **A. nitida** (13–21): **13.** habit, ×1; **14.** part of stem, ×5; **15.** stem in cross section, ×130; **16.** leaf, ×40; **17.** leaf in cross section, ×220; **18.** cells at leaf base, ×170; **19.** leaf areolation, ×640; **20.** leaf apex, ×130; **21.** spore ×190. (1–12, *Sim* 9223; 13–21, *Esterhuysen* 18475).

brown, dehiscence slits extending from base to apex; spores round, 25–35 μm, yellow, reticulate-papillose. Fig. 6: 1–12.

Originally described from a specimen collected by Harvey on Table Mountain, *A. subulata* has subsequently been collected on the East African Islands and in Australia, New Zealand and southern South America. The species has been re-collected several times in the Flora area, but only on Table Mountain. Map 5.

Vouchers: *Esterhuysen* 18599 (BOL); *Sim* 9223; *Wager* 104.

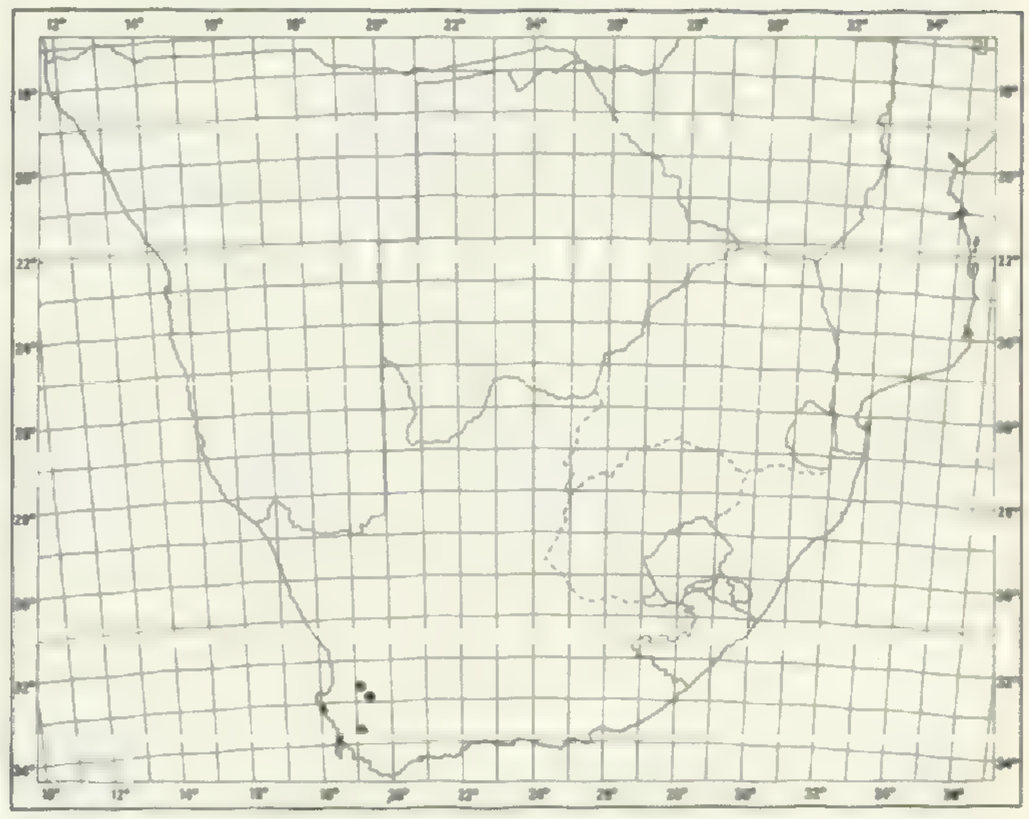
The small size of the plants and the costate, ovate-subulate leaves will place *A. subulata*. Occasionally high-altitude, rock-growing specimens of *Grimmia apocarpa* have been mistaken for this species. These specimens are also frequently small and reddish brown, but the larger leaves with broader apices and sinuolate leaf cells should separate these specimens.

2. **Andreaea nitida** *Hook. f. & Wils.* in J. Bot., Lond. 3: 535 (1844); Broth. in Natürl. PflFam. 10: 131 (1924); Schultze-Motel in Willdenowia 6: 89 (1970); Schelpe in Jl S. Afr. Bot. 41: 37 (1975). Type: Lord Auckland's Islands, *Hooker* s.n. (BM, holo.!).

Plants large, loosely tufted, reddish brown to black-green; saxicolous, semi-aquatic. *Stems* 20–120 mm long, branching; in section round, central strand absent, inner cortical cells in 5–6 rows, with thickened corners, outer cortical cells in 3 rows, smaller, strongly thickened. *Leaves* somewhat fragile, extremely variable in size, lower leaves small, becoming larger above, erect-spreading wet or dry; broadly elliptical, (1–)2–3 mm long, to 1,5 mm wide; apex broadly obtuse, abruptly apiculate; margins plane, entire. *Costa* broad below, tapering to mid-leaf, laterally spurred, cells in surface view elongate; in section cells weakly differentiated, slightly smaller, thick-walled. *Upper laminal cells* variable, quadrate, rectangular or triangular, weakly thickened, smooth.

Perichaetia terminal; leaves weakly differentiated from upper leaves. *Pseudopodia* 3–5 mm long, blackish; capsule exserted, elliptical, 2–3 mm long, dark red-black, dehiscence slits extending from mid-capsule to apex; spores round, 20–30 μm; brownish yellow, weakly papillose. Fig. 6: 13–21.

Rare in Southern Africa, *A. nitida* is more common in Australia, New Zealand, South America and a few Antarctic Islands. The species is presently known only from the Hexberg in the Cold Bokkeveld Mountains of the southwestern Cape. Map 5.



MAP 5.— ● **Andreaea bistratosa**
× **Andreaea subulata**
▲ **Andreaea nitida**

Voucher: *Esterhuysen* 18475 (BOL).

Andreaea nitida is identified by its broadly elliptical leaves and wide, spurred costa which tapers to mid-leaf. The size of the leaves increases considerably up the stem, especially on fertile plants. The size of the plants and leaf shape are very distinct from the other Southern African species of *Andreaea*, and the species is unlikely to be confused with other taxa after careful examination.

3. **Andreaea rupestris** *Hedw.*, Spec. Musc. 47 (1801); Scott & Stone, Moss. S. Aust. 62 (1976); Smith, Moss Fl. Brit. Irel. 81 (1978). Type: Europe.

Andreaea petrophila [Ehrh., 1784] Fuernr. in Flora, Jena 10: 30 (1827); Broth. in Natürl. PflFam. 10: 129 (1924); Sim, Bryo. S. Afr. 133 (1926). Type: Europe.

Plants small, forming cushions, red-brown to black-green; saxicolous. *Stems* 5–20 mm high, irregularly branched; in section round, central strand absent, inner cortical cells in 2–3 rows, corners thickened, outer cells in 2 rows, smaller, round, incrassate. *Leaves* appressed or with spreading apices dry, erect-spreading wet; ovate to oblong-lanceolate, occasionally constricted above base, 0,3–1,5 mm long; apex weakly cucullate, acute to obtuse; margins entire, incurved; lamina in section unistratose. *Costa* absent. *Upper laminal cells* quadrate, incrassate, frequently with strongly thickened corners, smooth to strongly papillose on dorsal surface; basal cells linear to rectangular, irregularly thickened; basal marginal cells short-rectangular to quadrate.

Autoicous. Perichaetia terminal; leaves elliptical, 2 mm long; apex obtuse. *Pseudopodia* 1–2 mm long, pale green; capsule just exserted, elliptical, to 1 mm long, dark red-brown; dehiscence slits extending from mid-capsule to near apex; spores round, 20–25 μm, yellow, weakly papillose. Fig. 7: 11–24.

Very widespread in distribution, *A. rupestris* is also the most commonly collected *Andreaea* in Southern Africa. Growing on bare rock, at high altitude, this species is known from mountains of the southwestern, central and eastern Cape and the Drakensberg of Lesotho, Natal and the Orange Free State. Map 6.

Vouchers: *Brenan* M2774; *Ellis* 7; *Esterhuysen* 34592; *Hilliard & Burtt* 10497; *Magill* 4416; *Schelpe* 2114; *Smook* 1112.

In Southern Africa, *A. rupestris* is identified by its generally red-brown colour, ecostate leaves and frequently papillose leaf cells. The plants tend to vary in size and leaf shape, but specimens are rarely difficult to identify. A broader interpretation of *A. rupestris* would undoubtedly encompass many of the ecostate species of *Andreaea* on the sub-Antarctic Islands.

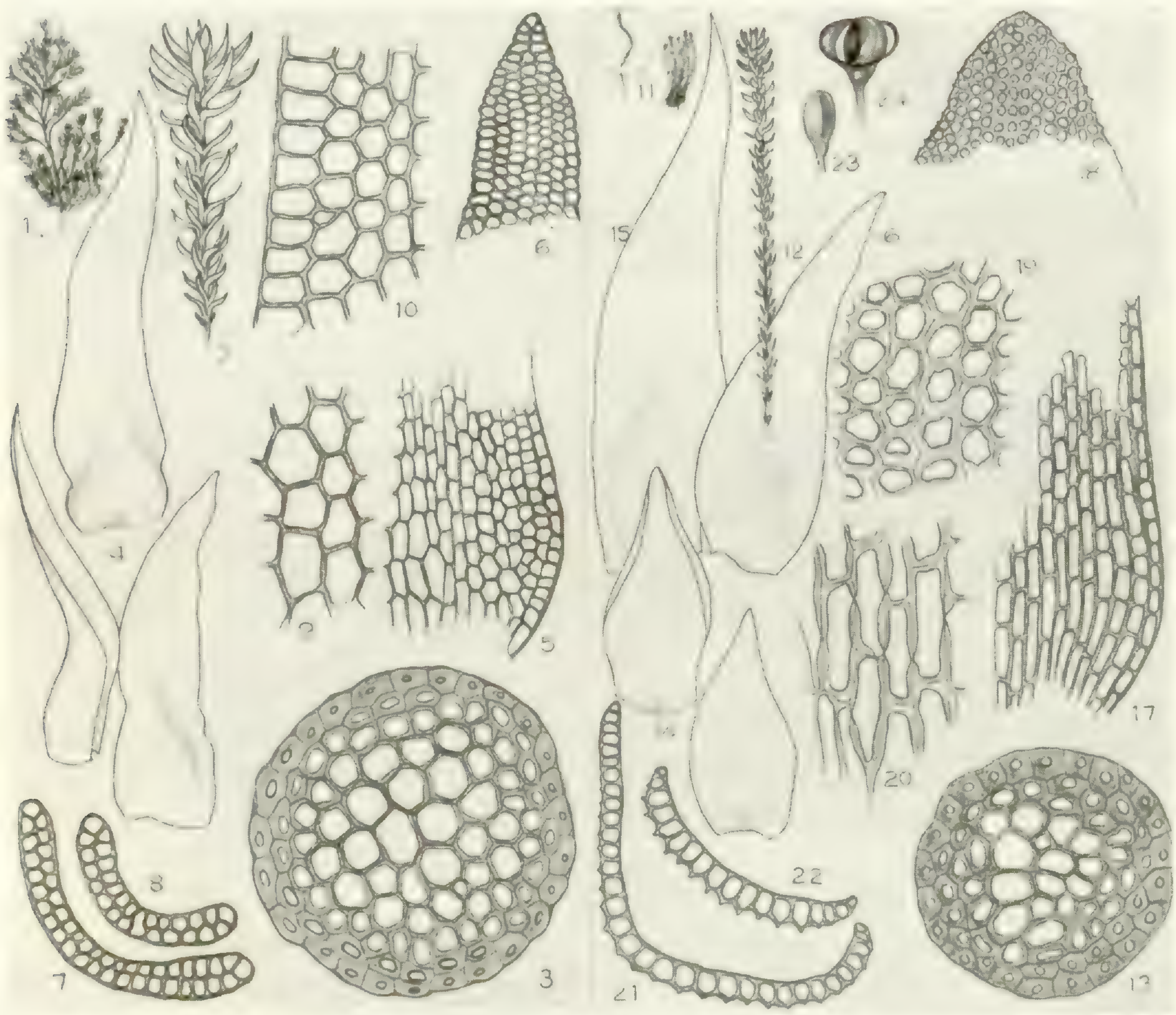
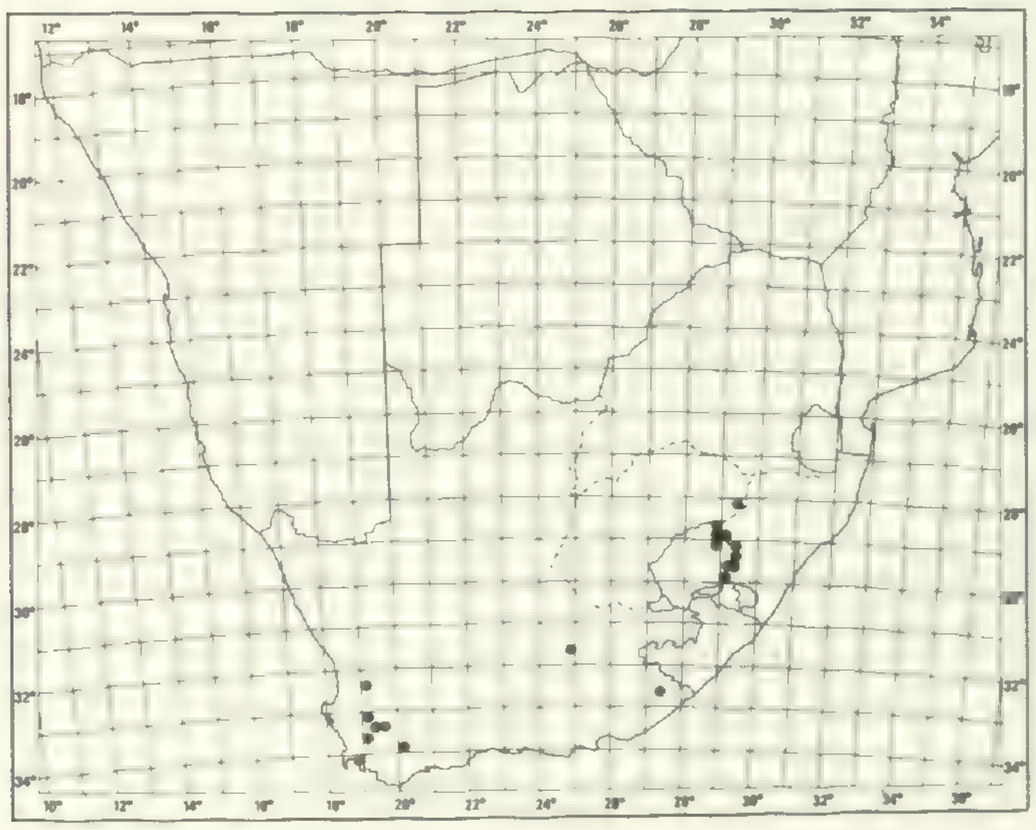


FIG. 7.—**Andreaea bistratosa** (1–10): **1.** habit, ×1; **2.** part of stem, ×5; **3.** stem in cross section, ×300; **4.** leaves, ×30; **5.** cells at leaf base, ×170; **6.** leaf apex, ×170; **7.** leaf in proximal cross section, ×170; **8.** leaf in distal cross section, ×170; **9.** basal leaf cells, ×640; **10.** upper laminal cells at margin, ×640. **A. rupestris** (11–24): **11.** habit, ×1; **12.** habit, ×5; **13.** stem in cross section, ×300; **14–16.** leaves, ×40; **17.** cells at leaf base, ×170; **18.** leaf apex, ×170; **19.** upper laminal cells, ×640; **20.** basal leaf cells, ×640; **21.** leaf in proximal cross section, ×170; **22.** leaf in distal cross section, ×170; **23.** capsule, intact, ×10; **24.** capsule, dehiscent and dry, ×10. (1–10, *Esterhuysen* 20601; 11–24, *Wager* PRE-CH12173).



MAP 6.— ● **Andreaea rupestris**

4. **Andreaea bistratosa** *Magill,* sp. nov., *formis* A. rupestris *Hedw. similis sed foliis anguste lanceolatis bistratosis et cellulis laminae regularibus, infirme incrassatis differt; speciebus austro-africanis aliis foliis ecostatis differt.*

Type: Cape, Schurweberg, on sandy wet rock surface in cool gully, 1 400 m, *Esterhuysen* 20601 (BOL, holo.; MO; PRE).

Plants small, forming loose cushions, blackish to brownish green; saxicolous. *Stems* 5–20 mm tall, irregularly branched; in section round, central strand absent, inner cortical cells in 3 rows, corners thickened, outer cortical cells in 2 rows, smaller, incrassate. *Leaves* appressed dry, widespreading above base wet, crowded above, fragile on lower stem, generally only leaf bases remaining; lanceolate, occasionally constricted above base, 1,0–1,5 mm long; apex acute; margins plane, entire; lamina in section bistratose, cells becoming slightly larger toward margins. *Costa* absent. *Upper laminal cells* hexagonal to quadrate, weakly papillose dorsally, becoming rhomboidal to rectangular below, weakly thickened; basal cells long-rectangular, thin-walled.

Dioicous. Perigonial buds terminal, rounded; leaves broadly ovate-acute, convolute; antheridia few. Perichaetia terminal; leaves similar to vegetative leaves, papillose dorsally; archegonia few. Sporophyte not known. Fig. 7: 1–10.

Endemic to Southern Africa, *A. bistratosa* has been collected on rock, above 1 400 m, in the mountains of the southwestern Cape. Map 5.

Voucher: *Esterhuysen* 25507.

Similar to forms of *A. rupestris,* this species is separated through its narrow, bistratose leaves and its very regular, weakly thickened laminal cells. *Andreaea bistratosa* is distinguished from the other Southern African species by its ecostate leaves.

FISSIDENTACEAE

Plants minute to large, generally forming dense mats; terricolous, saxicolous, corticolous or rarely aquatic. *Stems* erect or prostrate, generally simple; central strand present or absent. *Leaves* distichous and complanate, larger above, equitant, generally long, narrow, occasionally asymmetrical; lingulate to lanceolate or linear; in proximal transverse section Y-shaped, ventrally with 2 vaginant laminae clasping stem, dorsally with single lamina; apices acute to rounded; margins elimbate or completely to partly limbate, smooth, crenulate or serrate. *Costae* generally well developed, short-excurrent or ending below apex, rarely absent. *Vaginant laminae* equal or unequal, extending $\frac{1}{3}$ to $\frac{3}{4}$ of leaf length; dorsal lamina tapering proximally to insertion, frequently not reaching insertion or rarely decurrent. *Laminal cells* mostly small, quadrate to hexagonal, occasionally oblong-hexagonal or rhombic, flat to mammillose, smooth or papillose.

Perichaetia terminal or lateral. Seta elongate, erect or flexuose; capsules erect to inclined, urns short-cylindrical, symmetric or curved; peristome single, teeth 16, generally deeply cleft, reddish to red-yellow; operculum rostrate; calyptra cucullate; spores small, generally round.

A family of about 830 species in a single genus, *Fissidens*. Three other segregate genera have been recognized by some authors.

FISSIDENS

Fissidens *Hedw.*, Spec. Musc. 152 (1801); Broth. in Natürl. PflFam. 10: 144 (1924); Sim, Bryo. S. Afr. 185 (1926); Grout, Moss Fl. N. Amer. 1: 7 (1936); Gangulee, Moss. E. India 447 (1971). Lectotype species: *F. bryoides* Hedw., fide Britt. in Britt. Fl. Bermuda 435 (1916).

Octodiceras Brid., Muscol. Recent. Suppl. 1: 162 (1806); Smith, Moss Fl. Brit. Irel. 204 (1978). Type species: *O. fissidentoides* Brid.

Skitophyllum B. Pyl. in J. de Bot., sér. 2, 4: 133 (1814), nom. illeg.

Conomitrium Mont. in Annls Sci. nat. Bot., sér. 2, 8: 245 (1837), nom. illeg.

Moenkemeyera C. Müll. in Flora, Jena 69: 506 (1886); Broth. in Natürl. PflFam. 10: 154 (1924). Type species: *M. mirabilis* C. Müll.

With characters of the family.

The genus *Fissidens* comprises c. 830 currently recognized species. The genus has a worldwide distribution, with major centres of described species in South America (243) and Africa (268). Seventy-three species have been described or reported from the Flora area; of these Sim (1926) recognized 40 species. The number is here reduced to 28.

1 Plants small to minute; stems without central strand; leaves lacking costa (Subgenus *Aneuron*):
2 Leaves limbate; marginal leaf cells strongly differentiated, linear ..... 1. *F. enervis*
2 Leaves elimbate; marginal leaf cells quadrate to short-rectangular ..... 2. *F. usambaricus*
1 Plants small to large; stems with central strand, sometimes weak; leaves with costa short or long (Subgenus *Fissidens*):
3 Leaf cells lax, elongate-hexagonal to fusiform; costa short, ending well below apex (Section *Areofissidens*):
4 Leaves 2–4 mm long; leaf cells 60–110 μm long ..... 3. *F. wageri*
4 Leaves 0,5–2,0 mm long; leaf cells 20–50 μm long:
5 Leaves limbate; marginal cells elongate, leaf cells 20–32 μm long ..... 5. *F. capriviensis*
5 Leaves elimbate; marginal cells somewhat smaller, leaf cells 30–50 μm long ..... 4. *F. splachnifolius*

3 Leaf cells smaller with ± thickened walls; costa extending to near apex:
6 Leaves completely or in part limbate:
7 Limbidia present on all laminae, strong or weak (Section *Fissidens*):
8 Upper laminal cells regularly isodiametric, hexagonal or quadrate:
9 Vaginant laminae equal:
10 Laminal cells 4–6 μm long; limbidia 4–6 cells wide on proximal vaginant laminae.....7. *F. hoeegii*
10 Laminal cells 8–12 μm long; limbidia generally not broader on proximal vaginant laminae.....6. *F. bryoides*
9 Vaginant laminae unequal:
11 One blade of vaginant laminae terminating on lamina; limbidia intermarginal by 1–8 cells in proximal vaginant laminae; laminal cells bulging, 4–6 μm long.....8. *F. rufescens*
11 One blade of vaginant laminae terminating on costa; limbidia marginal throughout:
12 Leaves lanceolate; apex short-acuminate; laminal cells flat, quadrate to rhomboid, 15–18 μm long.....10. *F. simii*
12 Leaves ligulate to elliptical; apex acute to broadly acute, cuspidate; laminal cells bulging, quadrate, hexagonal or angular, 10–12 μm long.....9. *F. marginatus*
8 Upper laminal cells generally longer than broad or heterogeneous, rectangular and angular:
13 Limbidia weakly differentiated on vegetative leaves, frequently only a few elongated cells present on each lamina.....12. *F. stellenboschianus*
13 Limbidia strongly differentiated:
14 Leaves 1,0–2,0 mm long; laminal cells lax, 35–42 μm long.....13. *F. aciphyllus*
14 Leaves 0,7–0,8 mm long; laminal cells small, 10–17 μm long.....11. *F. curvatus*
7 Limbidia present on vaginant laminae of perichaetial leaves, frequently also on vaginant laminae of vegetative leaves, although usually weak to absent (Section *Semilimbidium*):
15 Leaf cells smooth:
16 Leaves very short, 0,3–0,5 mm long, broadly ovate to ligulate; one blade of vaginant laminae terminating on costa; apex of leaves on sterile plants bent abruptly backwards.....18. *F. pygmaeus*
16 Leaves longer, 0,6–1,2 mm long; one blade of vaginant laminae terminating on lamina:
17 Leaves lanceolate to elliptical, 0,6–0,8 mm long; apex acute; limbidia on vaginant laminae of perichaetial and subperichaetial leaves only; laminal cells irregular, short- to long-hexagonal, 12–17 μm long.....17. *F. parvilimbatus*
17 Leaves oblong, elliptical or asymmetrical, 0,7–1,2 mm long; apex obtuse to rounded; limbidia weak, generally only a few elongated cells on vaginant and dorsal laminae; laminal cells hexagonal, 10–12 μm long.....16. *F. microandrogynus*
15 Laminal cells papillose or mammillose:
18 Laminal cells sharply mammillose or with single spinose papilla:
19 Limbidia restricted to proximal ⅔ of vaginant laminae of perichaetial and subperichaetial leaves, broad at insertion, absent on lower leaves; costa subpercurrent; seta 0,6–0,8 mm long.....15. *F. scleromitrius*
19 Limbidia present on most leaves, reaching apex of vaginant laminae; costa short-excurrent; seta 2–4 mm long.....14. *F. submarginatus*
18 Laminal cells multipapillose, papillae low and blunt:
20 Leaves 0,4–0,7 mm long; costa ending 6–8 cells below apex.....21. *F. subobtusatus*
20 Leaves 0,8–1,4 mm long; costa percurrent or ending just below apex:
21 Laminal cells with 4–6 low, simple papillae over lumen, not obscuring cells, occasionally almost smooth; terricolous.....20. *F. erosulus*
21 Laminal cells obscured by numerous, low, dense, peripheral papillae; corticolous.....19. *F. borgenii*
6 Leaves without limbidia, marginal cells undifferentiated, occasionally bistratose:
22 Plants small; leaves 0,6–0,9 mm long; laminal cells weakly bulging to sharply mammillose (Section *Crenularia*).....22. *F. pseudoserratus*

22 Plants larger; leaves 1–7 mm long:
23 Plants 5–15 mm long; terricolous or saxicolous, occasionally semi-aquatic; leaves crowded:
24 Leaves unistratose throughout:
25 Dorsal lamina ending above insertion; stems without axillary hyaline nodules; costa ending below apex to percurrent (Section *Serridium*):
26 Leaf apices rounded to obtuse; costa ending below apex.....26. *F. asplenioides*
26 Leaf apices acute; costa percurrent.....25. *F. plumosus*
25 Dorsal lamina rounded at insertion, generally crumpled against stem; stems with axillary hyaline nodules; costa short-excurrent (Section *Crispidium*).....24. *F. glaucescens*
24 Leaves partly bistratose:
27 Leaf margins bistratose, rest of lamina unistratose (Section *Aloma*).....23. *F. nitens*
27 Superior and dorsal laminae bistratose (Subgenus *Pachyfissidens*).....27. *F. fasciculatus*
23 Plants 50–100 mm long, aquatic, floating; leaves distant (Subgenus *Octodiceras*)....28. *F. fontanus*

1. Subgenus **Aneuron**

Aneuron *Kindb.*, Eur. N. Am. Bryin. 2: 165 (1897).

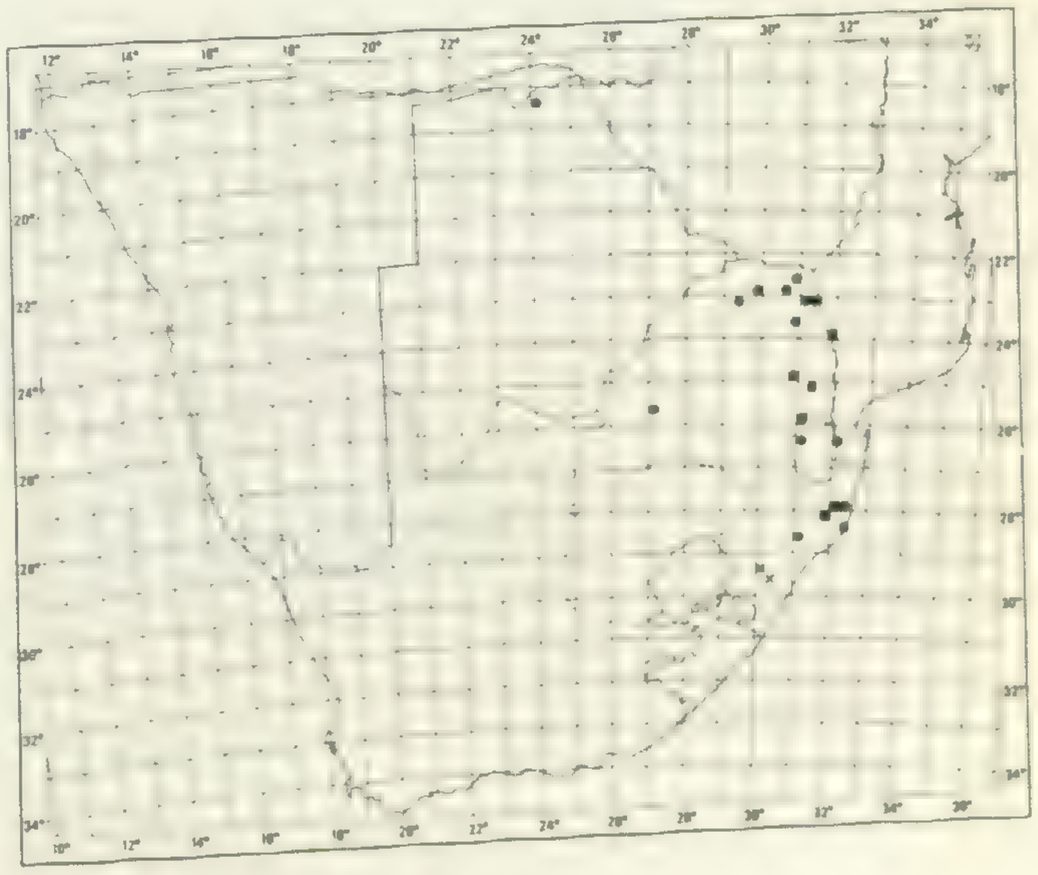
Plants small to minute, light green to glaucous; terricolous. *Stems* without central strand. *Leaves* limbate; costa absent; laminal cells lax.

Sporophyte terminal; *seta* long; capsules short-cylindrical; exothecial cells thickened in corners; stomata present in base; spores small.

1. **Fissidens enervis** *Sim* in Trans. R. Soc. S. Afr. 15: 187 (1926). Type: Natal, Pietermaritzburg, Town Bush Valley, *Sim* 9899 (PRE, lecto.!, selected here).

Plants very small to minute, scattered, light green; terricolous. *Stems* to 2 mm tall, simple; in section subround, central strand absent, cortical cells large, in 2 rows, weakly thickened. *Leaves* distant, longer above, very small below, weakly contorted dry, erect-spreading wet; narrowly lingulate to ligulate, 0,8–1,2 mm long; apex acute, abruptly apiculate; margins entire, limbidia distinct, present on all laminae; costa absent. *Vaginant laminae* equal, very small, narrow, ending near mid-leaf; dorsal lamina slightly tapered proximally, broadly attached at insertion, not decurrent. *Laminal cells* elongate-hexagonal, 30–50 μm long, 20–25 μm wide, lax, flat, smooth.

Perichaetia terminal, leaves narrow, 1,2 mm long. *Seta* to 3 mm long, yellow; capsule erect, urn ovate to cylindrical, 2,5–3,5 mm long, yellowish; exothecial cells quadrate, corners thickened; peristome reddish, deeply cleft; operculum rostrate, 0,3 mm long; calyptra just covering operculum, 0,3 mm long; spores round, 12–14 μm, spiculate. Fig. 8: 1–7.

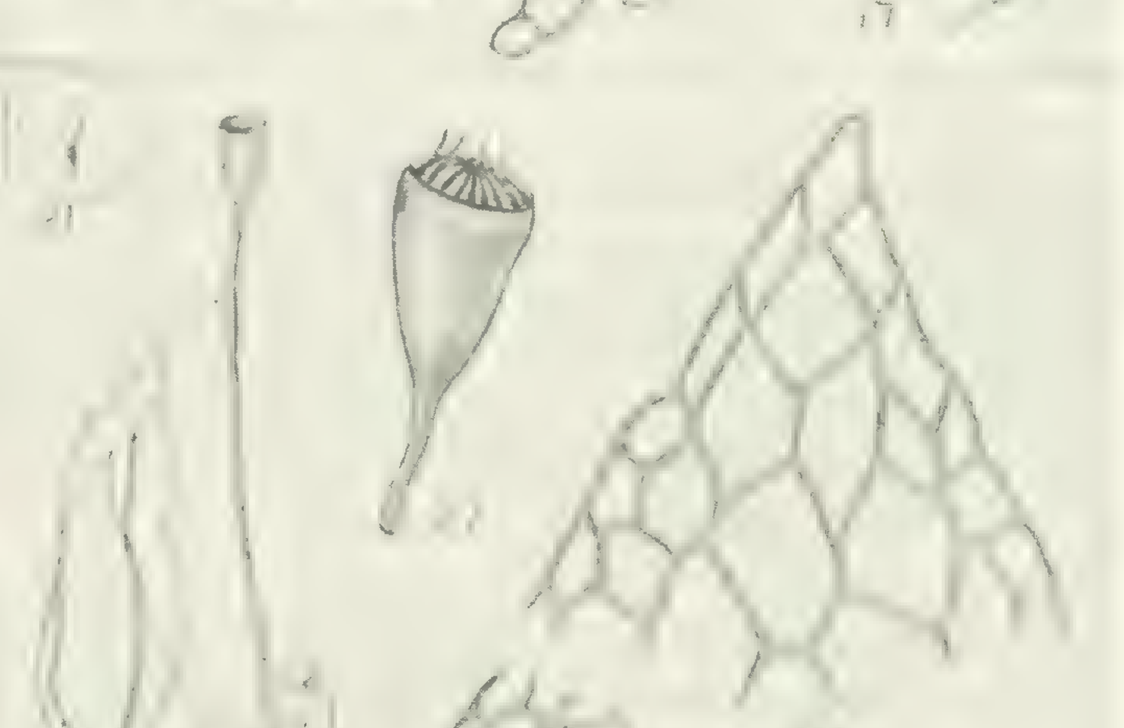


MAP 7.— ● **Fissidens erosulus**
× **Fissidens enervis**

Recently reported from central and eastern Africa (Bizot & Pócs, 1979). In Southern Africa, *F. enervis* is known only from the type locality in southern Natal. Map 7.

Vouchers: *Van der Bijl* PRE-CH5068; *Sim* 9900.

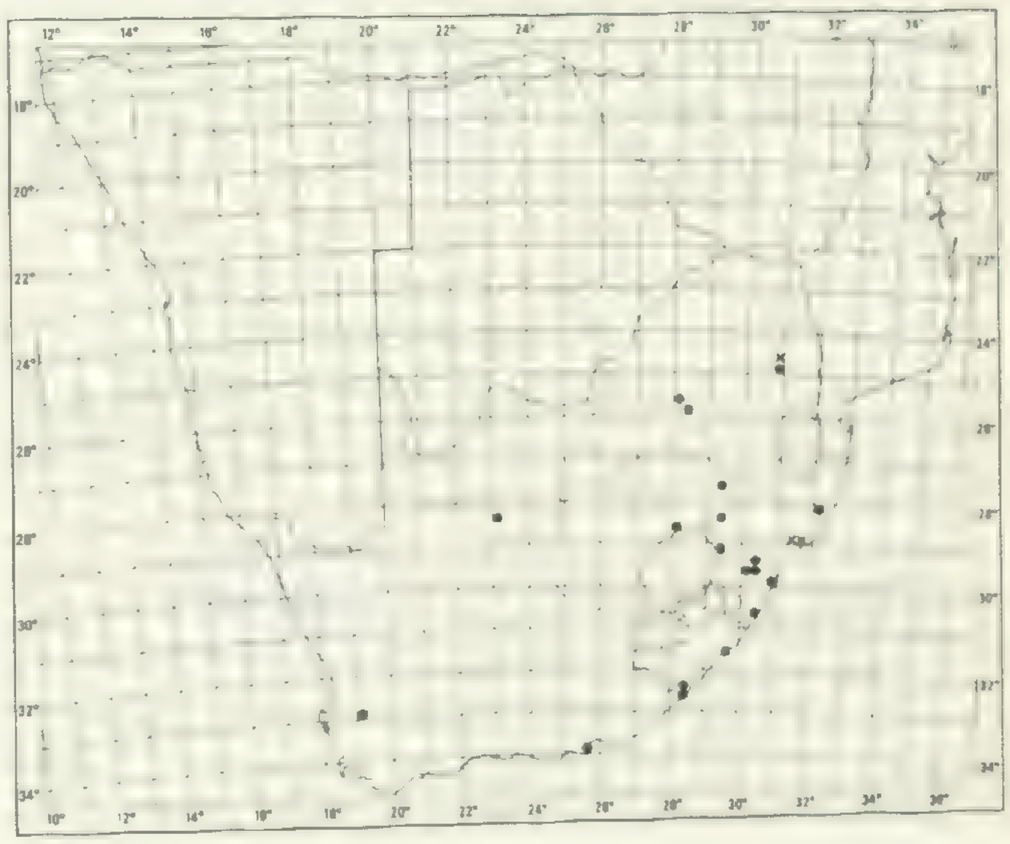
The species is very distinctive. The large cells, strong limbidia and absence of a costa will identify the species.



2. **Fissidens usambaricus** *Broth.* in Bot. Jb. 20: 182 (1894); Broth. in Natürl. PflFam. 10: 145 (1924). Type: Tanzania, Usambara, Lutindi, *Holst* 3472 (H, holo.).

Plants small, scattered, light green; terricolous. *Stems* 2–3 mm high, simple; in section elliptical, central strand absent, cortical cells lax, in 2–3 rows. *Leaves* distant, little altered dry; spathulate to lingulate, 1,2–1,4 mm long; apex obtuse; margins entire, very weakly bordered by smaller, narrower cells; costa absent. *Vaginant laminae* very narrow, extending $\frac{1}{3}$–$\frac{1}{2}$ of leaf length, termination of one blade marginal to submarginal; dorsal lamina gradually tapering proximally, broadly attached to stem, occasionally minutely decurrent. *Laminal cells* hexagonal to subhexagonal, 20–37 μm wide, lax; marginal cells narrower, short-rectangular; basal cells of vaginant laminae elongate-rectangular to rectangular, lax.

Dioicous. Perichaetia terminal; leaves slightly larger, spathulate. *Seta* 2–3 mm long, yellowish; capsule ± erect, urn short-elliptical, 0,4–0,6 mm long, yellowish; exothecial cells quadrate, corners strongly thickened; peristome teeth deeply cleft, red-brown; operculum rostrate, 0,4 mm long; calyptra small, just covering operculum; spores round, 10–12 μm, weakly papillose. Fig. 8: 8–13.



MAP 8.— ● **Fissidens fontanus**
× **Fissidens usambaricus**

Fissidens usambaricus is known from eastern, western and Southern Africa. In the Flora area, the species is found in forests and moist woodlands of the eastern Transvaal and Zululand. Map 8.

Vouchers: *Crosby & Crosby* 7801; *Vorster* 1569.

The elimbate, spathulate leaves, small, isodiametric leaf cells and absence of a costa will place specimens of *F. usambaricus*. The species has only recently been reported from Southern Africa (Magill & Schelpe, 1979).

2. Subgenus **Fissidens**

Plants small to large, light green or yellow-green to dark green; terricolous or corticolous. *Stems* with central strand. *Leaves* limbate or elimbate; costate; laminal cells generally small, rarely large, lax.

Sporophyte terminal or lateral; *seta* long or short; capsule short-cylindrical, erect to nodding; spores small.

1. Section **Areofissidens**

Areofissidens *C. Müll.*, Syn. Musc. 1: 46 (1848).

Plants small, light green to yellow-green; terricolous or rarely corticolous. *Leaves* limbate or elimbate; costa ending well below apex. *Laminal cells* large, lax.

FIG. 8.—**Fissidens enervis** (1–7): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×300; **4.** leaf, ×40; **5.** lower margin of dorsal lamina, ×435; **6.** leaf apex, ×435; **7.** capsule and operculum, ×20. **F. usambaricus** (8–13): **8.** habit, ×1; **9.** habit, ×10; **10.** leaf, ×25; **11.** leaf base, ×170; **12.** leaf apex, ×170; **13.** capsule and operculum, ×20. **F. wageri** (14–20): **14.** habit, ×1; **15.** habit, ×10; **16.** leaf, ×25; **17.** cells at base of vaginant lamina, ×160; **18.** cells at termination of vaginant lamina, ×160; **19.** leaf apex, ×160; **20.** leaf in median cross section, ×160. **F. splachnifolius** (21–27): **21.** habit, ×1; **22.** habit, ×10; **23.** leaves, ×40; **24.** cells at base of dorsal lamina, ×435; **25.** cells at termination of vaginant lamina, ×435; **26.** leaf apex, ×435; **27.** capsule, ×20. (1–7, *Sim* 9899; 8–10, *Crosby & Crosby* 7801; 11–13, *Vorster* 1569; 14–20, *Wager* 7764; 21–27, *Ecklon* s.n.).

3. **Fissidens wageri** *Dix. ex Wager* in Trans. R. Soc. S. Afr. 4: 1 (1914); Broth. in Natürl. PflFam. 10: 145 (1924); Sim, Bryo. S. Afr. 187 (1926). Type: Natal, Umkomaas, *Wager* s.n. (PRE!).

Plants medium-sized, scattered or in small groups, yellow-green; terricolous. *Stems* to 2 mm long, simple; in section round, central strand weak, cells with very thin walls, cortical cells large, thickened, in 4–5 rows. *Leaves* crowded above, little altered dry; elliptical to lingulate, 2–4 mm long; apex acute to broadly acute; margins elimbate, entire; costa present, extending to mid-leaf, ending a few cells above departure from vaginant laminae; in section cells differentiated. *Vaginant laminae* equal, extending $\frac{1}{2}$–$\frac{3}{4}$ of leaf length; dorsal lamina gradually tapering from mid-leaf to insection. *Laminal cells* fusiform to elongate-hexagonal, 60–110 μm long, 20–25 μm wide, flat, smooth.

Autoicous. Perigonia gemmate, axillary. Perichaetia terminal; leaves undifferentiated, 4 mm long. *Seta* to 10 mm long, yellow; capsule nodding to inclined, urn curved, 1,5 mm long, yellowish; exothecial cells quadrate, thin-walled; peristome teeth cleft above middle, reddish; operculum short-rostrate; spores round, 12–15 μm, spiculate. Fig. 8: 14–20.

Endemic to Southern Africa, *F. wageri* is found in the coastal and inland forests of Zululand, Natal and Transkei. Map 9.

Vouchers: *Pegler* 1358; *Van der Plank* 109.

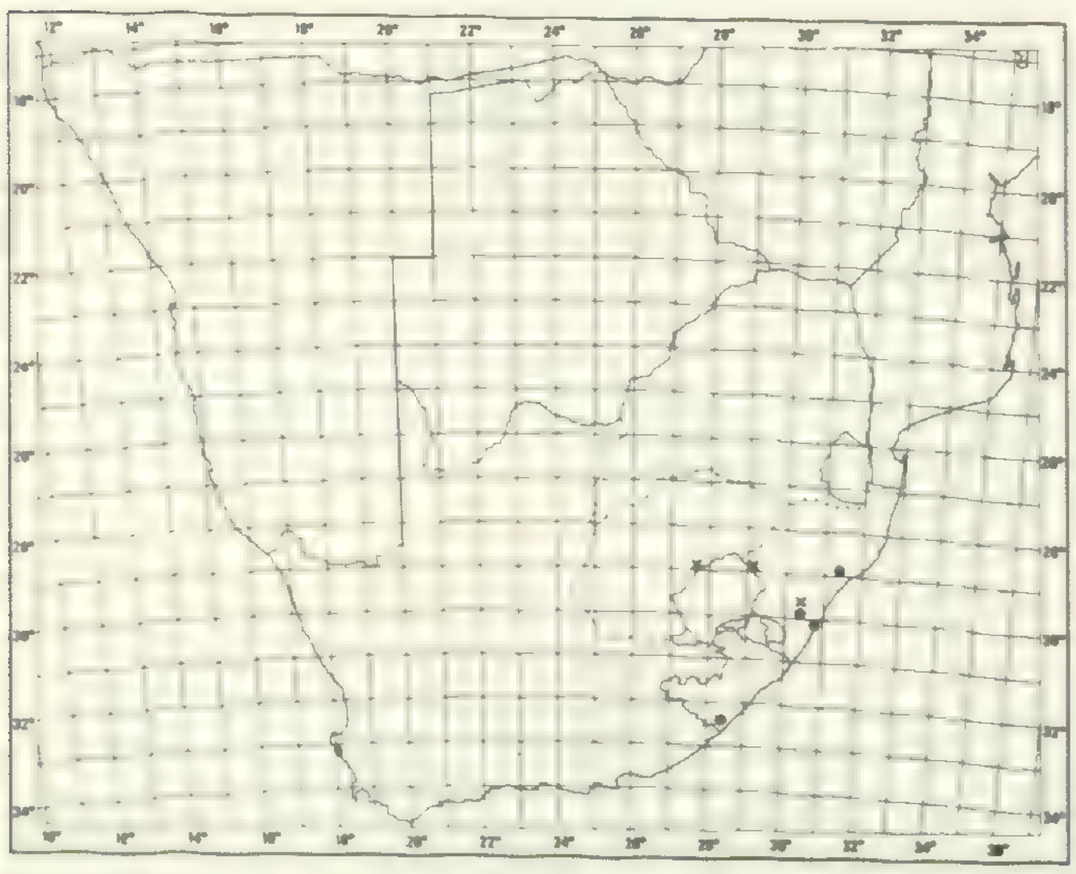
Fissidens wageri was originally described as ecostate. The routine mounting of specimens in Hoyer's medium revealed a weak costa in leaves of the type. Transverse sections of the leaves exposed a costa with differentiated internal anatomy. The presence of the costa necessitates moving the species from subgen. *Aneuron* to subgen. *Fissidens* section *Areofissidens*.

The species is defined by the large fusiform leaf cells, weak limbidia, and costa ending far below apex. The species is not likely to be confused with any other Southern African species.

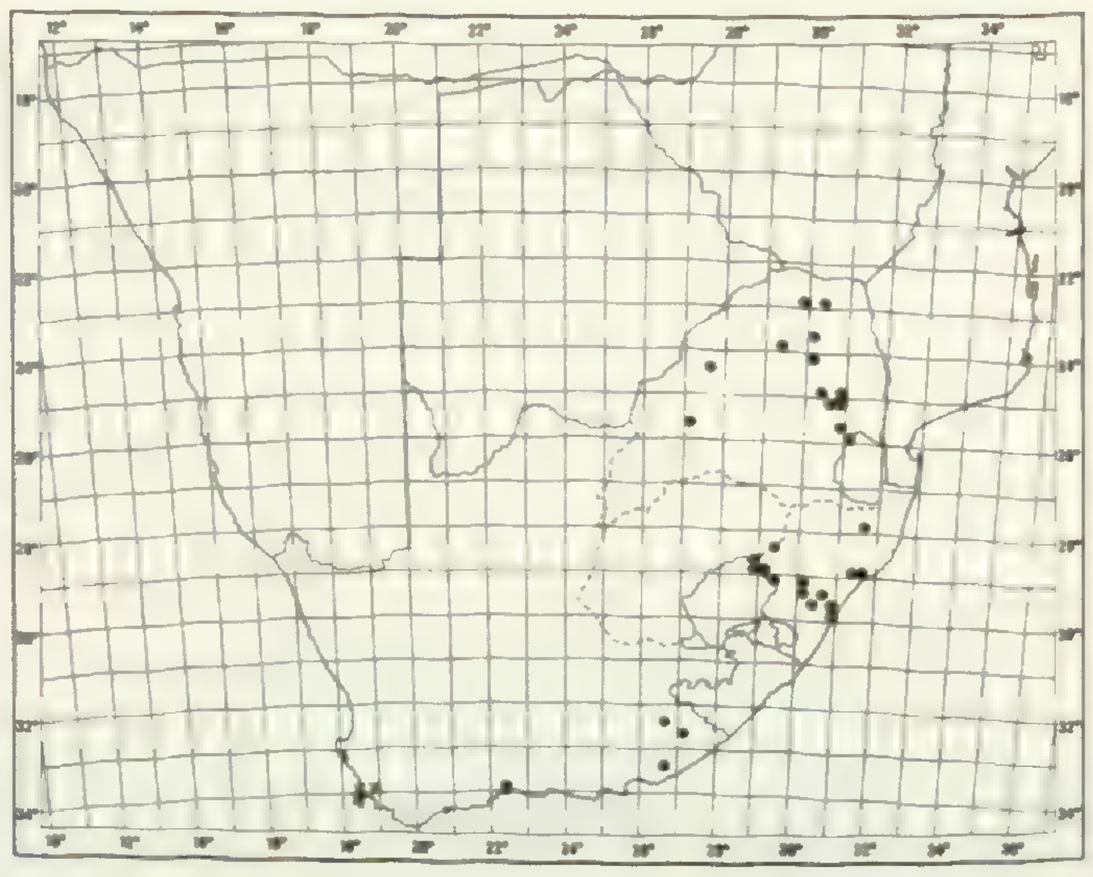
4. **Fissidens splachnifolius** *Hornsch.* in Linnaea 15: 145 (1841); Broth. in Natürl. PflFam. 10: 148 (1924). Type: Cape, Table Mountain, *Ecklon* s.n., Aug. 1827 (H-BR!).

Fissidens arnellii P. Varde in Revue bryol. lichen. 23: 266 (1954). Type: Cape, Orange Kloof, *Arnell* 2180 (PC, holo.!).

Plants very small, scattered, light green; terricolous. *Stems* 1–2 mm high, simple; in section subround, central strand present, collapsed, cortical cells in 3 rows, large, irregularly shaped. *Leaves* erect dry, erect-spreading wet; asymmetrically ovate-spathulate, weakly panduriform, 0,5–1,0 mm long; apex acute, apiculate; margins entire, weakly bordered by smaller marginal cells; costa weak, ending well below apex, to $\frac{1}{2}$ or $\frac{3}{4}$ of leaf length. *Vaginant laminae* to $\frac{3}{4}$ of leaf length, termination of one blade laminal to submarginal; dorsal lamina gradually tapering proximally, weakly decurrent. *Upper laminal cells* hexagonal to elongate-hexagonal, 30–47 μm long, 20–25 μm wide, lax, smooth; margi-



MAP 9.— ● **Fissidens wageri**
× **Fissidens hoeegii**



MAP 10.— ● **Fissidens asplenioides**
× **Fissidens splachnifolius**

nal cells narrow, rectangular; basal cells rectangular.

Dioicous. Perichaetia terminal; leaves undifferentiated, 1,5–1,8 mm long. *Seta* 4–5 mm long, reddish yellow; capsule erect to horizontal, urn very short-cylindrical, weakly curved, 0,3–0,6 mm long, reddish yellow; exothecial cells quadrate to short-rectangular, longitudinal walls thickened; peristome teeth deeply cleft, reddish; operculum not seen; spores round, 17–20 μm, weakly papillose. Fig. 8: 21–27.

Endemic to the southwestern Cape, the species has been collected in the fynbos of Table Mountain and on the Cape Peninsula. Map 10.

Voucher: *Schelpe* 7320 (BOL).

Examination of type material clearly indicates that Sim's (1926) interpretation of this species was incorrect. The species described and illustrated by him is clearly *F. pygmaeus* (=*F. bifrons*); see note under that species.

The type specimen of *F. splachnifolius* is smaller than plants of more recent collections, both in overall size and the number of cells across width of upper leaf. Comparison of a number of other characters indicate, at this time, that all of these specimens represent a single species.

5. **Fissidens capriviensis** *Magill*, sp. nov., F. bocarangensi *P. Varde* et F. flaccido *Mitt. similis, sed habitatione corticola, statura minore, forma foliorum et cellulis laminae minoribus differt; in Sectione* Areofissidente

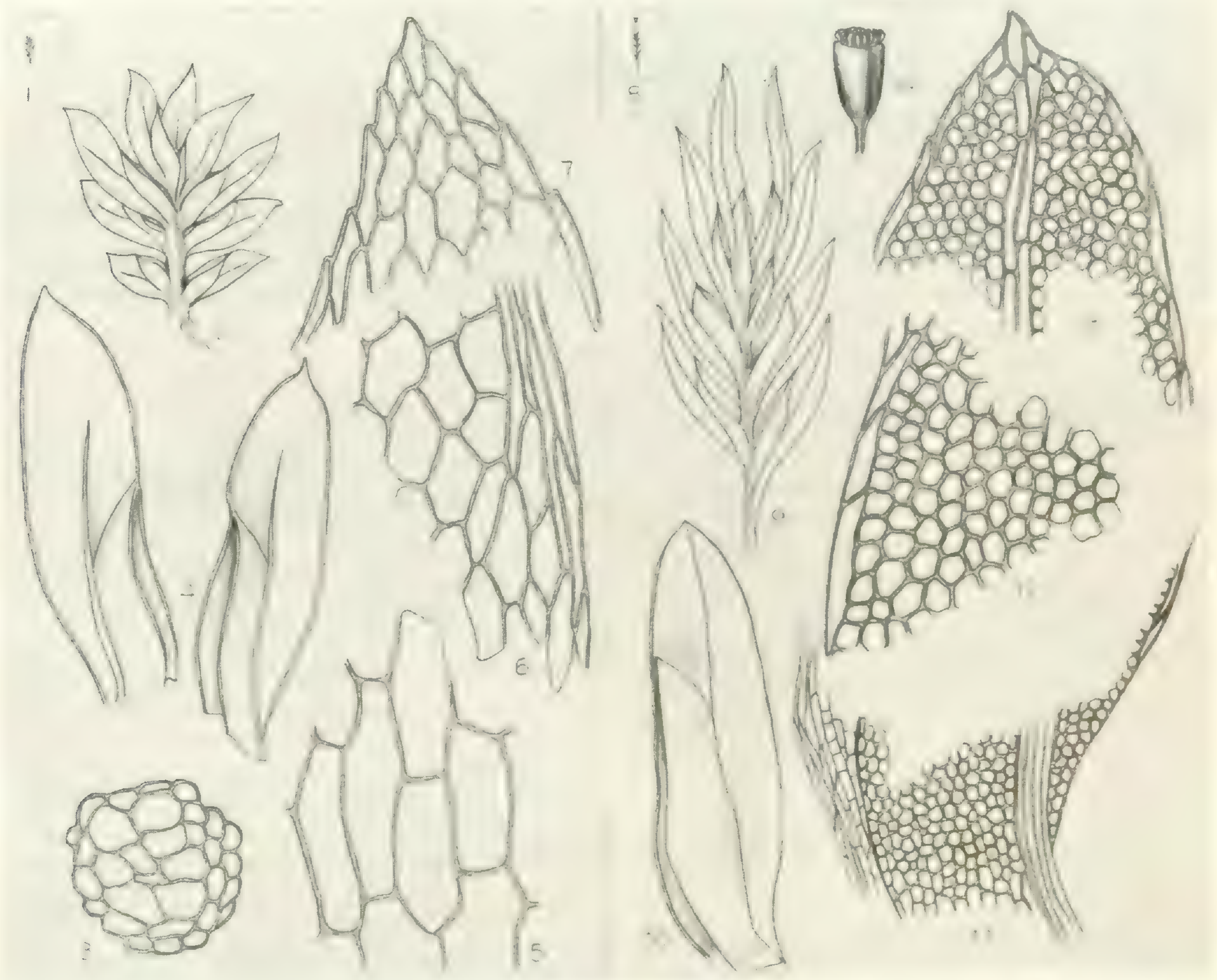


FIG. 9.—**Fissidens capriviensis** (1–7): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×240; **4.** leaves, ×60; **5.** upper laminal cells, ×640; **6.** cells at margin of dorsal lamina, ×640; **7.** leaf apex, ×640. **F. hoeegii** (8–14): **8.** habit, ×1; **9.** habit, ×10; **10.** leaf, ×40; **11.** leaf base, ×435; **12.** cells at margin of dorsal lamina, ×640; **13.** leaf apex, ×435; **14.** capsule, ×20. (1–7, *Vahrmeijer* 122; 8–14, *Magill* 5584).

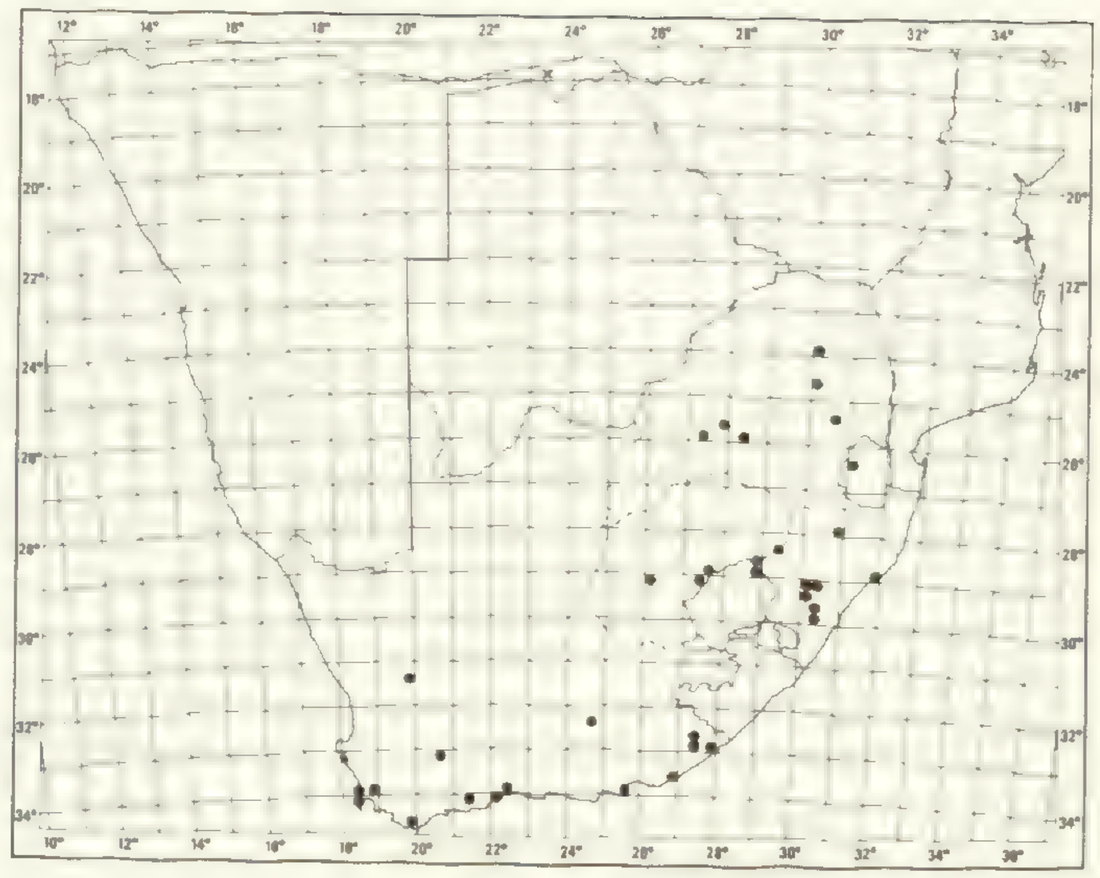
propter limbidias bene distinctas laminis omnibus, cellulas laminae magnas, costam distinctam terminatam infra apicem ponitur.

Type: South West Africa/Namibia, Caprivi Strip, on trees in mixed dry woodlands, *Vahrmeijer* 122 (PRE, holo.; MO; NY).

Plants small, scattered, dark green; corticolous. *Stems* 1–2 mm high; in section oval, central strand very small or absent, cortical cells in 3–4 rows, large, thin-walled, smaller toward margin. *Leaves* distant below, crowded above, bent backwards dry, erect-spreading wet; elliptical to spathulate, 0,6–1,1 mm long, smaller below; apex acute; base narrowed; margins entire, limbate on all laminae; costa weak, ending well below apex. *Vaginant laminae* equal, ½–⅔ of leaf length; dorsal lamina gradually tapering proximally, rounded at insertion. *Laminal cells* elongate-hexagonal, 20–32 μm long, 5–10 μm wide, thin-walled, flat; basal cells rectangular, 25–37(45) μm long, 12–15 μm wide, thin-walled.

Sporophyte unknown. Fig. 9: 1–7.

The plants were collected in woodlands of the Caprivi Strip, northeastern South West Africa/ Namibia. Map 11.



MAP 11.— ● **Fissidens curvatus**
× **Fissidens capriviensis**

Voucher: Type only.

The species is similar to *F. bocarangensis* P. Varde and *F. flaccidus* Mitt. but differs from both in being corticolous, as well as in the smaller plant size, leaf shape and shorter leaf cells. The well defined limbidia, large leaf cells and distinct costa distinguish the species from other Southern African species.

2. Section **Fissidens**

Fissidens emend. *Norkett ex Gangulee*, Moss. E. India 453 (1971).

Plants small to medium; terricolous. *Leaves* with limbidia on all laminae, strong or weak; costa percurrent to short-excurrent. *Laminal cells* small, smooth, flat or mammillose.

6. **Fissidens bryoides** *Hedw.*, Spec. Musc. 153 (1801); Broth. in Natürl. PflFam. 10: 146 (1924); Crum, Mosses of the Great Lakes Forest 59 (1973); Pursell & Hoe in J. Hattori bot. Lab. 43: 83 (1977). Type: Europe.

Fissidens androgynus Bruch ex Krauss in Flora, Jena 29: 134 (1846); Broth. in Natürl. PflFam. 10: 146 (1924); Sim, Bryo. S. Afr. 197 (1926). Type: Cape, Devil's Peak, *Krauss* s.n. (BM!).

? *Fissidens remotifolius* C. Müll., Syn. Musc. 1: 60 (1848); Broth. in Natürl. PflFam. 10: 146 (1924). Type Cape, *Zeyher* 41.

Fissidens gueinzii C. Müll. in Linnaea 37: 168 (1872); Broth. in Natürl. PflFam. 10: 146 (1924); Sim, Bryo. S. Afr. 198 (1926). Type: Cape, *Gueinzius* s.n. (BM!).

Fissidens subremotifolius C. Müll. in Hedwigia 38: 54 (1899); Broth. in Natürl. PflFam. 10: 146 (1924). Type: Transvaal, Lydenburg, *Wilms* s.n., Apr. 1887, herb. Jack (G, holo.!).

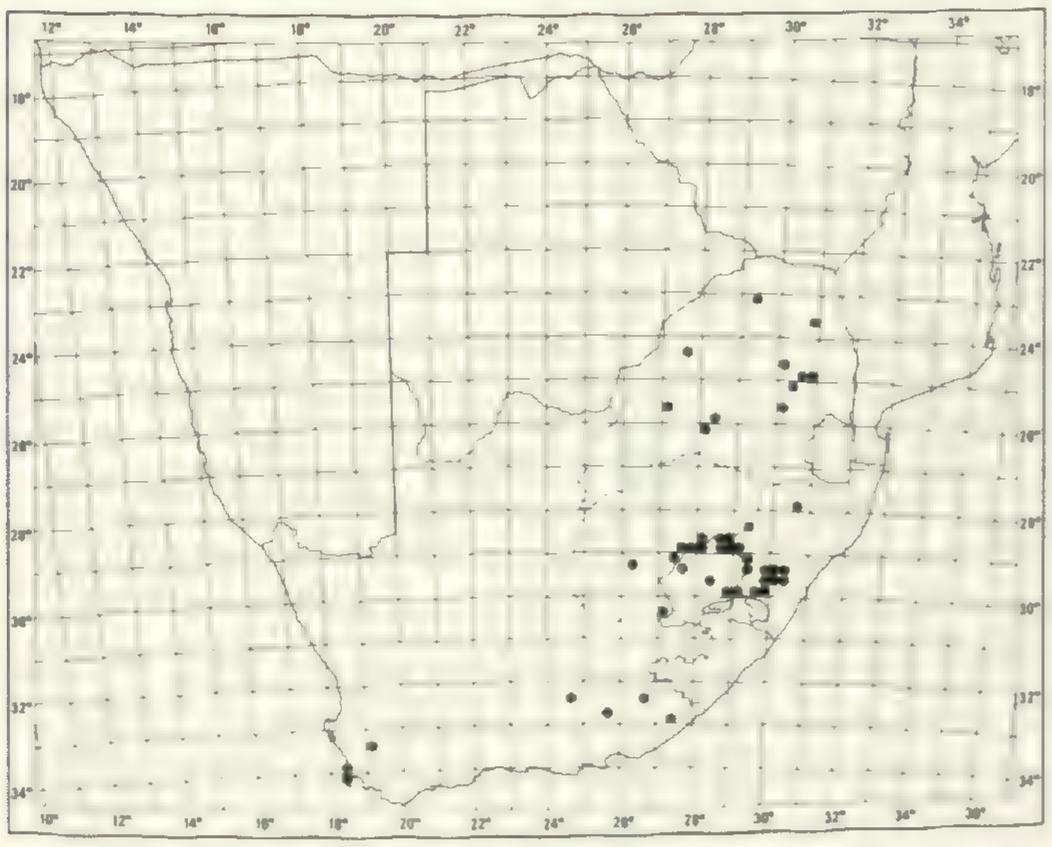
Fissidens malacobryoides C. Müll. in Hedwigia 38: 55 (1899); Broth. in Natürl. PflFam. 10: 146 (1924); Sim, Bryo. S. Afr. 200 (1926). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n. (G!).

Plants medium-sized forming loose groups, dark green; terricolous. *Stems* to 10 mm high, infrequently branched below; in section subround to elliptical, central strand present, inner cortical cells large, thin-walled, outer cortical cells in 1–2 rows, smaller, incrassate. *Leaves* evenly spaced, contorted dry, erect-spreading wet; ovate or ligulate to elliptical, occasionally asymmetrically ovate-elliptical, 1–2 mm long; apex broadly acute to cuspidate; margins entire to serrulate at apex; limbidia strong on all laminae, confluent with costa or ending a few cells below apex, generally ending above base of dorsal laminae; costa percurrent to short-excurrent.

Vaginant laminae equal, to ⅔ of leaf length; dorsal lamina abruptly narrowing proximally, rounded to insertion, occasionally weakly decurrent. *Laminal cells* rounded, quadrate to hexagonal, 8–12 μm long, flat or occasionally bulging, smooth.

Autoicous. Perichaetia terminal; leaves somewhat larger. *Seta* 3–6 mm long, yellowish; capsules erect to inclined, urn straight to curved, (0,6–)0,8–1,0 mm long, reddish yellow; exothecial cells short-rectangular, longitudinal walls thickened, cells at mouth quadrate; peristome deeply cleft, reddish; operculum rostrate, 0,4–0,5 mm long; spores round, 11–21 μm, weakly papillose. Fig. 10: 1–8.

This widely distributed species is known from Europe, Africa, North America, southern South America, Asia and Oceania. In Southern Africa the species is found in grasslands of the Transvaal, Orange Free State, Lesotho, Natal and the eastern, central and southwestern Cape. Sporophytes were only found on specimens at upper elevations in and around Lesotho. Map 12.



MAP 12.— ● **Fissidens bryoides**

Vouchers: *Crosby & Crosby* 7771; *Garside* 6201; *Magill* 3328, 4367; *Schelpe* 2110.

Fissidens bryoides has been confused with several other species of section *Fissidens*. It is recognized by the vaginant laminae being equal and the large, flat leaf cells.

The species varies in development of both costa and limbidium. The costa is generally percurrent to short-excurrent, but may end 1–3 cells below apex. The limbidium may be very strong, extending from insertion to apex where it is confluent with the costa or it may be weak, ending above insertion and below apex.

7. **Fissidens hoeegii** *P. Varde* in K. norske Vidensk. Selsk. Skr. 5: 130 (1932). Syntypes: Natal, Umgeni, Pietermaritzburg, *Hϕeg* 423, 430 (PC!), 432 (PC!; PRE!).

Plants small, in loose groups, yellow-green to dark green; terricolous. *Stems* 3–6 mm tall, simple; in section subround, central strand small, inner cortical cells large, in two rows, lax, smaller toward margin, outer cortical cells stereids, in 1–2 rows, brownish. *Leaves* not crowded, contorted dry, erect-spreading wet; ligulate to oblong-elliptical, 1,2–1,3 mm long; apex acute; margins entire, limbidia present on all laminae, ending just below apex, and ending above insertion on dorsal lamina, broader on proximal vaginant laminae, to 4–6 rows of rectangular cells; costa percurrent. *Vaginant laminae* equal, to ¾ of leaf length; dorsal lamina gradually tapering proximally, extending to insertion or slightly decurrent. *Laminal cells* hexagonal to subhexagonal, 5–7 μm long, superficially bulging, smooth; quadrate in proximal vaginant laminae.

Perichaetia terminal; leaves ligulate, to 1,5 mm long. *Seta* 4 mm long, reddish yellow; capsule ± erect, urn cylindrical, 0,8 mm long, yellowish; exothecial cells short-rectangular, longitudinal walls thickened, quadrate at mouth, strongly incrassate; peristome cleft to near base, yellowish red; operculum short-rostrate; spores round, 25–32 μm, very weakly papillose. Fig. 9: 8–14.

Recently reported from Tanzania (Bizot & Pócs, 1979). In Southern Africa, *F. hoeegii* is known from kloof forests of Natal and eastern Orange Free State. Map 9.

Vouchers: *Cholnoky* 104; *Magill* 5584.

The species is similar to *F. bryoides* but differs in smaller, bulging leaf cells and a broad limbidium on proximal vaginant laminae. The equal vaginant laminae will separate *F. hoeegii* from the other species in this section.

8. **Fissidens rufescens** *Hornsch.* in Linnaea 15: 153 (1841); Broth. in Natürl. PflFam. 10: 146 (1924); Sim, Bryo. S. Afr. 198 (1926). Syntypes: Cape, Lion's back, *Ecklon* s.n., Sept. & Nov.; Table Mountain, *Ecklon* s.n., Oct.; Devil's Peak, *Ecklon* s.n., Dec. (All BM!).

Fissidens megalotis Schimp. ex C. Müll. in Bot. Ztg 16: 154 (1858); Broth. in Natürl. PflFam. 10: 149 (1924); Sim, Bryo. S. Afr. 193 (1926). Type: Cape, Greenkloof, *Breutel* s.n. (BM, holo.!).

Fissidens breutelii, p.p. quoad Cape, Soutkloof, *Breutel* s.n. (BM!), syntype of *F. breutelii* Schimp. ex C. Müll. in Bot. Ztg 17: 198 (1859).

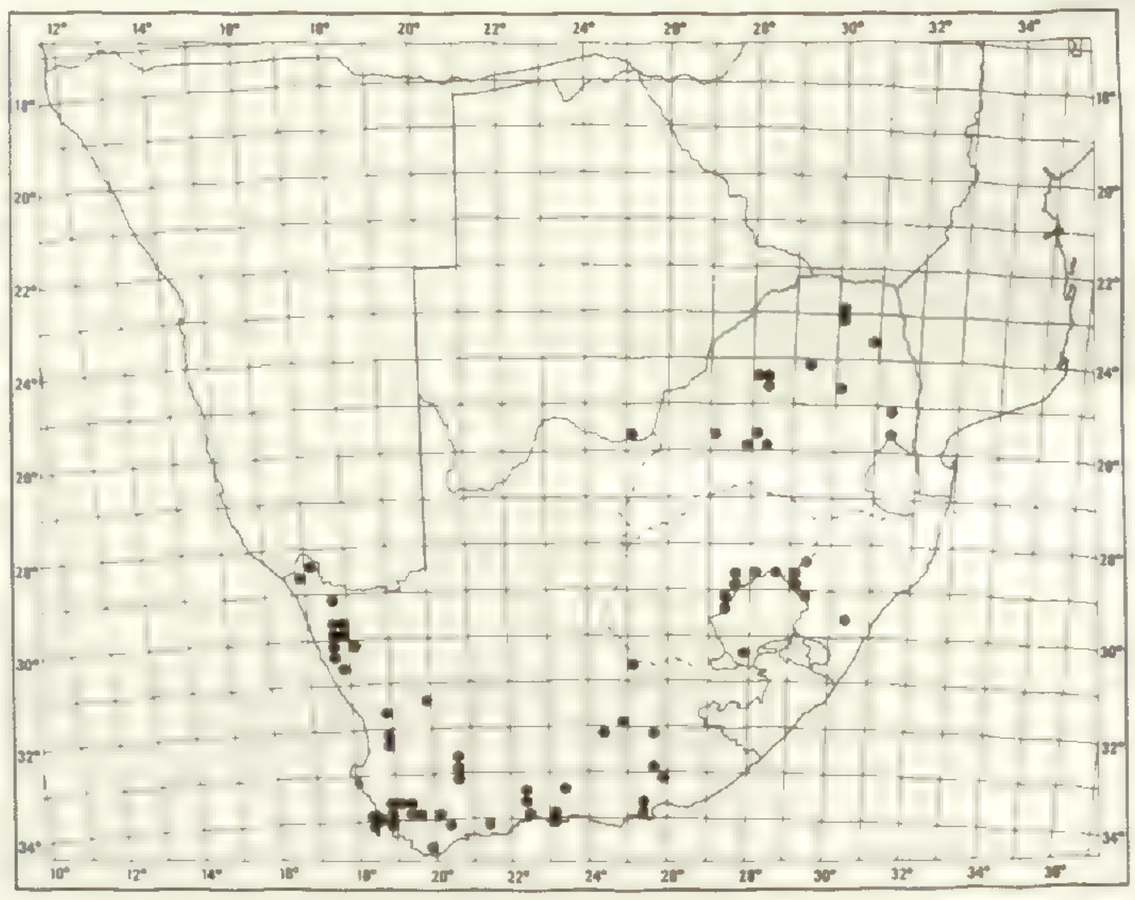
Fissidens macowanianus C. Müll. in Hedwigia 38: 58 (1899); Broth. in Natürl. PflFam. 10: 146 (1924). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1883 (HBG!; BM!).

Fissidens minutiretis Dix. in K. norske Vidensk. Selsk. Skr. 1932 (4): 5 (1932). Type: Cape, Signal Hill, *Moss & Moss* 9261 (BM, holo.!).

Plants small to medium, scattered or forming loose groups, dark green to yellow-green; terricolous. *Stems* 4–8 mm high, simple; in section elliptical, central strand present, inner cortical cells large, outer cortical cells in 2 rows, stereids to substereids. *Leaves* ± crowded, compressed or weakly contorted dry, erect-spreading wet; ligulate to elliptical or frequently asymmetrical, broadly ovate-ligulate 0,5–1,8 mm long; apex acute, cuspidate; margins serrulate at apex, entire below or occasionally serrulate on vaginant laminae, limbidia present on all laminae, strong or weak, confluent with costa or ending a few cells below apex and ending above insertion on dorsal lamina, submarginal to intermarginal by 1–8 cells, on proximal vaginant laminae, occassionally spurred; costa short-excurrent. *Vaginant laminae* open to closed, to ⅔ of leaf length; termination of one blade submarginal to laminal or almost at costa; dorsal lamina gradually tapering proximally, just reaching insertion or weakly decurrent, rarely rounded to insertion. *Laminal cells* rounded, quadrate to subhexagonal, 4–6 μm long, weakly thickened, mammillose to bulging, smooth.

Perichaetia terminal; leaves elongate, asymmetrically ovate-ligulate, 2,0–2,5 mm long. *Seta* 5–7 mm long, yellowish; capsule inclined to horizontal, urn ± asymmetrical, curved, 0,8–1,0 mm long, yellow-brown; exothecial cells quadrate, longitudinal walls thickened; peristome deeply cleft, reddish; operculum rostrate; spores round, 15–18 μm, weakly papillose. Fig. 10: 9–16.

Endemic to Africa, *F. rufescens* has been reported from the eastern and southern parts of the continent. In Southern Africa the species is widespread in drier regions of Transvaal, Natal, Lesotho, Orange Free State and Cape. A few specimens have also been collected in Botswana. The species is not known from South West Africa/Namibia, although its presence in the northwestern Cape indicates that it may be found in the southern parts of South West Africa/Namibia. Map 13.



MAP 13.— ● **Fissidens rufescens**

Vouchers: *De Winter* 9601; *Magill* 3204, 4648, 6250; *Smook* 1412.

The species is recognized by the unequal vaginant laminae, intermarginal limbidia on proximal vaginant laminae and small, mammillose leaf cells. The character of intermarginal limbidia was found to be variable but useful. In the western Cape the limbidia are generally 6–8 cells deep on the proximal vaginant laminae. In other parts of the Cape, Orange Free State and Natal the depth is most frequently 3–6 cells, while in the Transvaal 1–3 is more common. Another character, that of open vaginant laminae, also shows similar variation. In the western Cape the laminae are conspicuously open, wet or dry, while eastern and northern collections have laminae only weakly open to closed.

The specimens reported from Southern Africa (Schelpe, 1979) as *F. vittatus* Hook. f. & Wils. belong here. Judging from the description and illustrations published by Scott & Stone (1976), it is probable

FIG. 10.—**Fissidens bryoides** (1–8): **1.** habit, ×1; **2.** habit, ×10; **3.** leaf, ×35; **4.** leaf base, ×435; **5.** cells at termination of vaginant lamina, ×435; **6.** leaf apex, ×435; **7.** upper laminal cells, ×640; **8.** capsule, ×20. **F. rufescens** (9–16): **9.** habit, ×1; **10.** habit, ×10; **11–13.** leaves, ×35; **14.** leaf base, ×435; **15.** cells at margin of dorsal lamina, ×640; **16.** leaf apex, ×435. **F. marginatus** (17–24): **17.** habit, ×1; **18.** habit, ×10; **19–20.** leaves, ×35; **21.** cells at lower margin of dorsal lamina, ×435; **22.** cells at lower margin of vaginant lamina, ×435; **23.** cells at termination of vaginant lamina, ×435; **24.** leaf apex, ×435. **F. simii** (25–31): **25.** habit, ×1; **26.** habit, ×10; **27.** leaf, ×55; **28.** leaf base, ×170; **29.** cells at termination of vaginant lamina, ×170; **30.** cells at margin of dorsal lamina, ×640; **31.** leaf apex, ×170. (1–2 & 8, *Magill* 4614; 3–7, *Bosman* 1165; 9–10, *Schelpe* 4917; 11–16, *Magill* 4076; 17–18, *Wager* 294; 19–24, *Rehmann* 290; 25–26, *Oliver* 7148; 27–31, *Sim* 9907).

that the Australian species is synonymous with *F. rufescens;* however, further observations must be made.

9. **Fissidens marginatus** *Schimp. ex C. Müll.* in Bot. Ztg 16: 154 (1858); Broth. in Natürl. PflFam. 10: 146 (1924); Sim, Bryo. S. Afr. 199 (1926). Type: Cape, Table Mountain, *Ecklon* s.n., (BM, holo.!).

Fissidens breutelii Schimp. ex C. Müll. in Bot. Ztg 17: 198 (1859). Type: Cape, Gnadenthal, *Kuhn* s.n. (BM, lecto.!, selected here).

Fissidens ischyrobryoides C. Müll. in Hedwigia 38: 55 (1899); Broth. in Natürl. PflFam. 10: 146 (1924). Type: Cape, Devil's Peak, *Rehmann* 290 (PRE!).

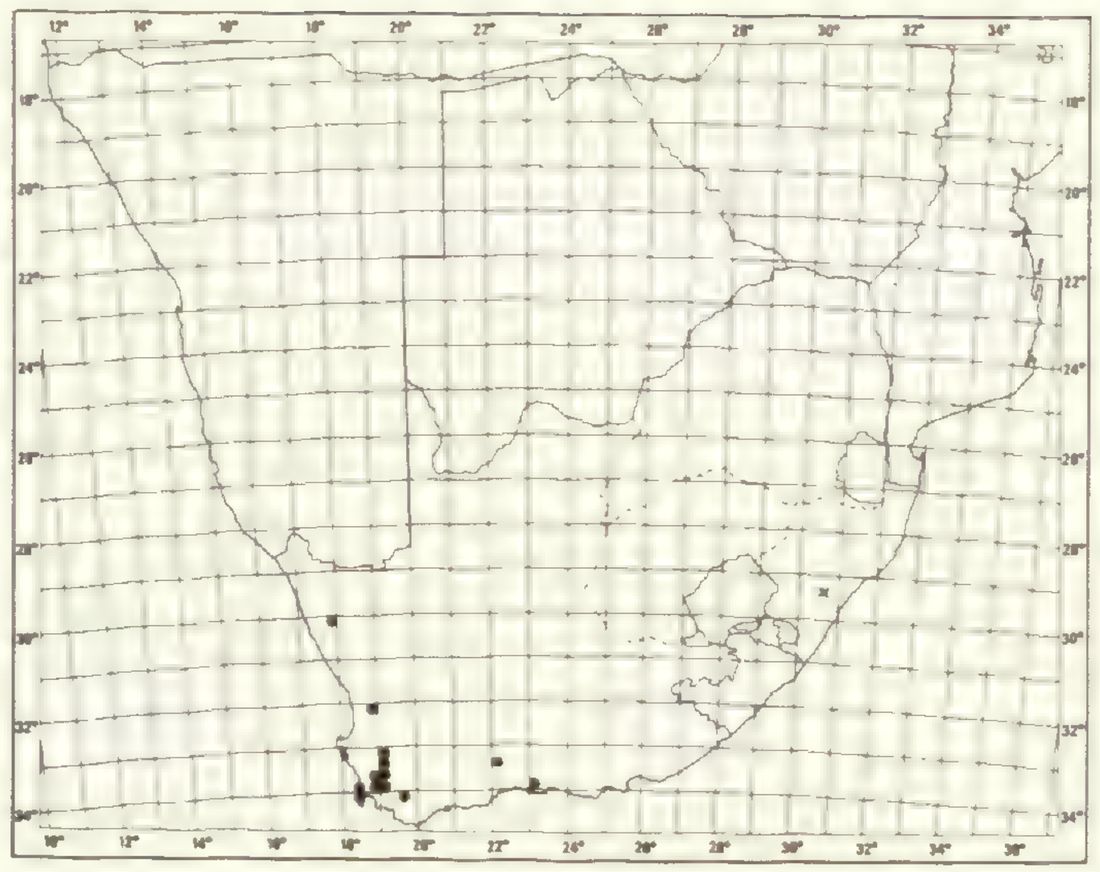
Plants small to medium, forming loose groups, green, glossy; terricolous. *Stems* 4–8 mm high, simple; in section subround, central strand present, inner cortical cells large, outer cortical cells in 1–3 rows, smaller, incrassate. *Leaves* evenly spaced, weakly contorted dry, widespreading wet; ligulate to ovate-lingulate or elliptical, 1–2 mm long; apex acute to broadly acute, cuspidate; margins serrulate to serrate at apex, entire below, limbidia strong on all laminae, confluent with costa or ending just below apex; costa short-excurrent. *Vaginant laminae* ½–¾ of leaf length, one blade abruptly rounded distally, terminating on costa; dorsal lamina only slightly tapering proximally, weakly decurrent. *Laminal cells* irregularly shaped, rounded, quadrate to hexagonal or angular, 8–12 μm long, weakly thickened, bulging.

Perichaetia terminal, occasionally polysetaceous; leaves asymmetrical ovate-lingulate, 1,4 mm long. *Seta* 5–7 mm long, yellow to reddish; capsule inclined to horizontal, urn asymmetrical, to 1 mm long, reddish; exothecial cells short-rectangular, longitudinal walls thickened; peristome deeply cleft, reddish; operculum long-rostrate, 0,6 mm long; spores round to subreniform, 15–20 μm, smooth, green. Fig. 10: 17–24.

Recently reported from Tanzania by Bizot, Pócs & Sharp (1979). In Southern Africa, *F. marginatus* is found in drier coastal regions of the western and southern Cape. Map 14.

Vouchers: *Esterhuysen* 24364; *Pare* 4; *Stokoe* PRE-CH12813.

The abrupt distal rounding of one blade of the vaginant laminae and its strong termination on the costa will separate *F. marginatus* from all other Southern African species except *F. simii*. The size and shape of leaves and laminal cells will separate the latter.



MAP 14.— ● **Fissidens marginatus**
× **Fissidens scleromitrius**

The syntypes of *F. breutelii* Schimp. ex C. Müll. are discordant elements; the Kuhn specimen is selected above as lectotype and the Breutel specimen is treated in the synonomy of *F. rufescens* Hornsch.

10. **Fissidens simii** *Schelpe* in Mem. bot. Surv. S. Afr. 43: 5 (1979). Syntypes: Natal, Pietermaritzburg, *Sim* 9903, 9907, 9909 (PRE!).

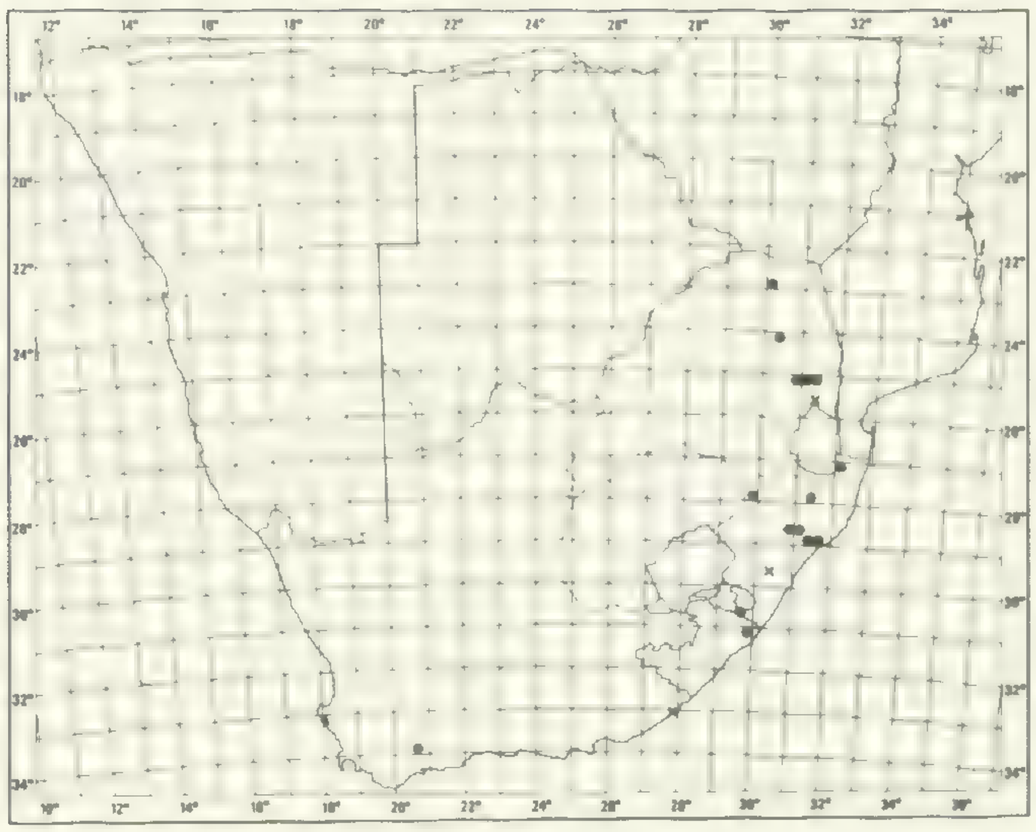
Fissidens aristatus Sim, hom. illeg., Bryo. S. Afr. 200 (1926), non Broth. (1916).

Plants small, scattered, light green; terricolous. *Stems* 3–5 mm high, simple; in section subround, central strand present, cortical cells smaller toward margin, outer row substereids, reddish. *Leaves* distant, little altered dry, erect-spreading wet; elliptical to lanceolate, 0,8–1,1 mm long; apex short-acuminate; margins entire, strongly limbate throughout; costa percurrent to short-excurrent. *Vaginant laminae* to mid-leaf, one blade narrowing distally, terminating on costa; dorsal lamina rounded at insertion. *Laminal cells* quadrate to rhombic, 12–16 (–20) μm long, weakly incrassate, smooth, flat.

Sporophyte not seen. Described by Sim (1926) as terminal, seta long; capsule inclined to horizontal, urn short-cylindrical; operculum short-rostrate. Fig. 10: 25–31.

Fissidens simii was described from Natal. The species, although rare, also occurs in the eastern Cape, eastern Transvaal and in eastern Africa (Bizot & Pócs, 1979). Map 15.

Vouchers: *Oliver* 7148; *Wager* PRE-CH11966.



MAP 15.— ● **Fissidens borgenii**
× **Fissidens simii**

The species is identified by its elliptical to lanceolate leaves, termination of one blade of the vaginant laminae on the costa and large, flat laminal cells.

11. **Fissidens curvatus** *Hornsch.* in Linnaea 15: 148 (1841); Broth. in Natürl. PflFam. 10: 146 (1924); Sim, Bryo. S. Afr. 188 (1926). Type: Cape, Mr Auret's garden, Löwenrücken, *Ecklon* s.n., 24 Oct. 1827 (H-BR!).

Fissidens laxifolius Hornsch. in Linnaea 15: 149 (1841); Broth. in Natürl. PflFam. 10: 149 (1924); Sim, Bryo. S. Afr. 189 (1926). Syntypes: Cape, Mr Breda's garden under Table Mountain, *Ecklon* s.n., 15 Aug. 1827; Table Mountain, *Ecklon* s.n., 1 Jun. 1827; Table Mountain, *Ecklon* s.n., 30 Aug. 1826 (H-BR!).

Fissidens cuspidatus C. Müll. in Linnaea 17: 588 (1843); Broth. in Natürl. PflFam. 10: 146 (1924); Sim, Bryo. S. Afr. 196 (1926). Type: Cape, Krakakammae, *Ecklon* s.n. (Hb. Kunze).

Conomitrium gracile Hampe ex C. Müll. in Bot. Ztg 17: 197 (1859). *Fissidens gracilis* (Hampe) Jaeg., hom. illeg., Enum. Fiss. 12 (1869), vide Dix. in Sim, Bryo. S. Afr. 197 (1926). Type: Cape, Elim, *Breutel* s.n.

Fissidens pycnophyllus C. Müll. in Hedwigia 38: 57 (1899); Broth. in Natürl. PflFam. 10: 147 (1924); Sim, Bryo. S. Afr. 187 (1926). Type: Cape, Cape Town, *Rehmann* 293 (PRE!).

Plants small, scattered, yellow-green, glossy; terricolous. *Stems* 1–3 mm long, simple; in section subround, central strand present, inner cortical cells large, in single row, outer cortical cells in 2 rows, small, substereids. *Leaves* larger above, slightly contorted dry, erect-spreading wet; linear-lanceolate to lanceolate, 0,7–0,8 mm long; apex acute; margins entire, strongly limbate throughout; costa percurrent. *Vaginant laminae* narrow, to upper ⅓ of leaf, termination of one blade variable, marginal or laminal; dorsal lamina gradually tapering proximally, generally ending above insertion. *Upper laminal cells* irregularly shaped, rounded, angular, elongate-hexagonal or rectangular, 10–17 μm long, smooth, flat; basal cells of vaginant laminae generally rectangular.

Autoicous. Perigonia gemmate, axillary. Perichaetia terminal; leaves asymmetrically broadly ovate-lanceolate, 1,2 mm long. *Seta* (1,2–)4–6 mm long, yellow; capsule inclined, urn short-cylindrical, 0,8 mm long, yellowish; exothecial cells quadrate to short-rectangular, weakly thickened; peristome deeply cleft, reddish; operculum rostrate; spores round, 14–17 μm, weakly papillose. Fig. 11: 1–8.

Endemic to Southern Africa, *F. curvatus* is infrequently collected in grasslands or shrublands of the southwestern, central, southern and eastern Cape Province, Orange Free State, Natal, Swaziland and the central, eastern and northern Transvaal. Map 11.

Vouchers: *Kemp* 853; *Magill* 3291, 4087; *Vahrmeijer* PRE-CH12644.

The small, narrow leaves and very strong yellowish border distinguish specimens of *F. curvatus* (see note under *F. stellenboschianus*). The shape of the laminal cells is rather variable. Individual collections generally exhibit only one of the cell patterns known for the species, but several collections have been seen with a heterogeneous cell pattern.

Seta length and degree of inclination of the capsule also show considerable variation. The type of *F. curvatus* has a very short seta and slightly inclined capsule. Frequently specimens have setae up to 6 mm long and capsules nearly horizontal.

12. **Fissidens stellenboschianus** *Dix. ex Sim*, Bryo. S. Afr. 195 (1926). Type: Cape, Stellenbosch, *Wager* 612 (BM, holo.!; PRE!).

Plants small, scattered, light green; terricolous. *Stems* to 1 mm long, simple; in section oval, central strand small, cortical cells large, lax, outer row smaller, incrassate. *Leaves* crowded, little altered dry; narrowly elliptical, 0,5–0,7 mm long; apex acute; margins serrulate at apex, entire below, weakly limbate on all laminae, leaves of sterile plants with a few elongated cells on vaginant and dorsal laminae, limbidia stronger on leaves of fertile plants, extending to just above termination of vaginant laminae, ending below apex and above base on dorsal lamina; costa percurrent to very short-excurrent.

Vaginant laminae ±½ leaf length, termination of one blade submarginal; dorsal lamina gradually tapering proximally to insertion. *Laminal cells* irregularly shaped, shortly oblong-hexagonal, 12–20 μm long; basal cells of vaginant laminae short-rectangular.

Dioicous. Perichaetia terminal; leaves narrow, asymmetrically ovate-lingulate, to 1 mm long. *Seta* to 3 mm long, yellowish; capsule ± erect, urn short-cylindrical, 0,5 mm long; exothecial cells quadrate to short-rectangular, incrassate; peristome irregular, teeth not cleft, lanceolate, apices abruptly rounded, 0,1 mm long; operculum short-rostrate; spores not seen. Fig. 11: 18–23.

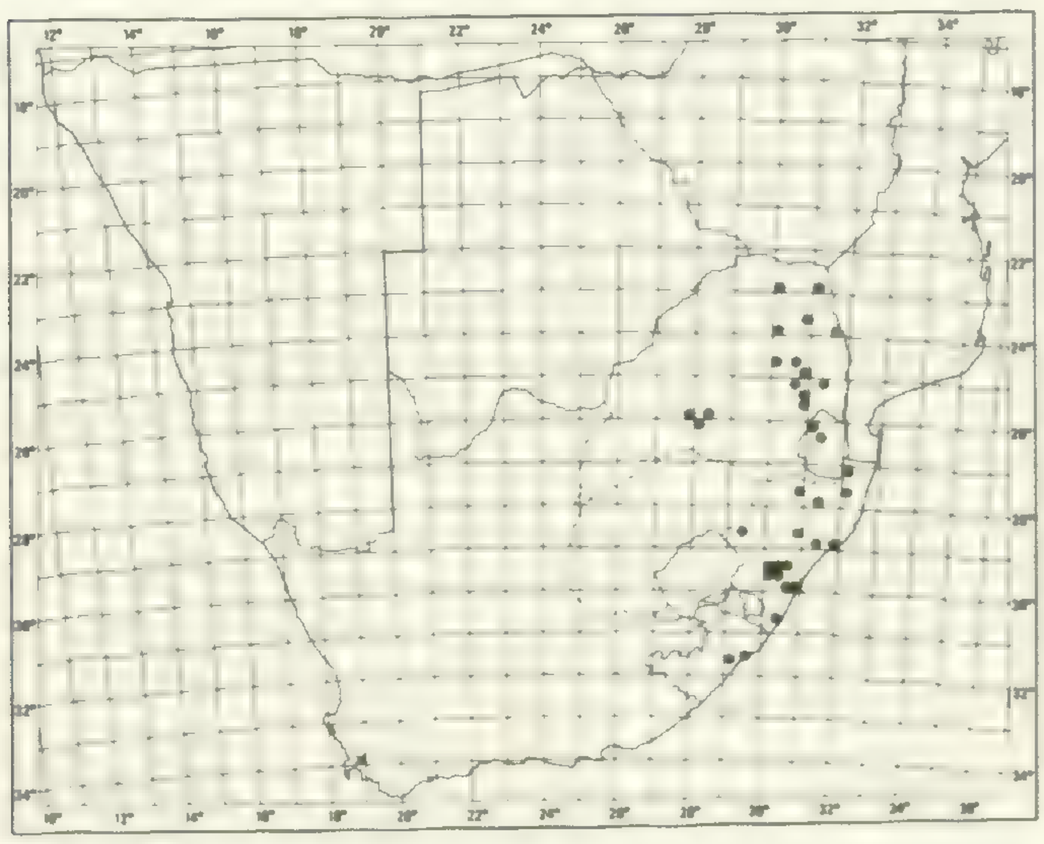
Fissidens stellenboschianus has recently been reported from Tanzania (Bizot, Pócs & Sharp, 1979). In Southern Africa the species is known only from the fynbos biome of the southwestern Cape. Map 16.

Voucher: Type only.

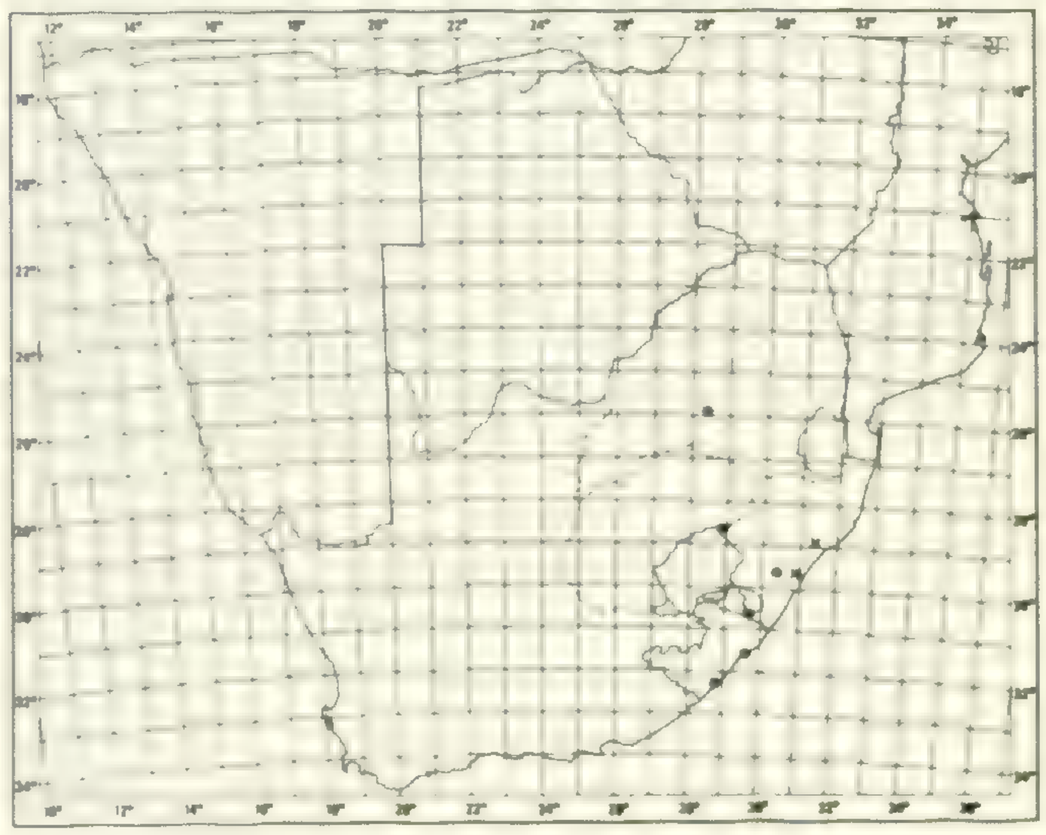
Fissidens stellenboschianus is very closely related to *F. curvatus*. The two species are separated primarily on the basis of limbidial development. The limbidia of *F. curvatus* are strong on all laminae. Extending from above the insertion to the apices, the limbidia are confluent with the costae. The limbidia of *F. stellenboschianus* are weak to absent in leaves of sterile plants and only weakly developed on vegetative leaves of fertile plants. The limbidia are stronger on perichaetial and subperichaetial leaves, but do not reach the apex. *Fissidens stellenboschianus* is probably only a variation of *F. curvatus;* however, intermediates were not seen. The species is provisionally maintained until additional material can be examined.

13. **Fissidens aciphyllus** *Dix.* in Trans. R. Soc. S. Afr. 18: 250 (1930). Type: Transkei, Port St Johns, *Wager* 927 (BM, holo.!; PRE!).

Plants small, scattered, light green; terricolous. *Stems* 3–4 mm tall, simple; in section subround, central strand present, cortical cells lax, outer row smaller, incrassate. *Leaves* larger above, little altered dry; ± asymmetrical, ovate-lanceolate to lanceolate or narrowly elliptical, 1,0–2,0 mm long; apex short-acuminate; margins entire, limbate on all laminae, broader on vaginant lamina; costa percurrent to short-excurrent. *Vaginant laminae* extending to mid-leaf, termination of one blade laminal; dorsal lamina narrowing proximally to insertion. *Laminal cells* large, lax, hexagonal to elongate-hexagonal, 30–45



MAP 16.— ● **Fissidens submarginatus**
× **Fissidens stellenboschianus**



MAP 17.— ● **Fissidens aciphyllus**
× **Fissidens nitens**

FIG. 11.—**Fissidens curvatus** (1–8): **1.** habit, ×1; **2.** habit, ×10; **3.** leaf, ×40; **4.** leaf, ×70; **5.** cell at base of dorsal lamina, ×435; **6.** laminal cells, ×435; **7.** cells at margin of dorsal lamina, ×640; **8.** leaf apex, ×435. **F. aciphyllus** (9–17): **9.** habit, ×1; **10.** habit, ×10; **11.** leaf, ×33; **12–13.** leaves, ×15; **14.** cells at base of vaginant lamina, ×170; **15.** cells at termination of vaginant lamina, ×170; **16.** leaf apex, ×170; **17.** laminal cells, ×435. **F. stellenboschianus** (18–23): **18.** habit, ×1; **19.** habit, ×10; **20.** leaf, ×80; **21.** leaf base, ×435; **22.** leaf apex, ×435; **23.** cells at margin of vaginant lamina, ×435. **F. nitens** (24–30): **24.** habit, ×1; **25.** habit, ×10; **26.** stem in cross section, ×290; **27.** leaf ×33; **28.** leaf base, ×170; **29.** upper laminal cells at margin, ×640; **30.** leaf apex, ×170. (1–2, *Kemp* 853; 3–8, *Vahrmeijer* PRE-CH12646; 9–17, *Wager* 1446; 18–23, *Wager* 612; 24–30, *Rehmann* 289).

μm long, 12–17 μm wide, flat, smooth; basal cells of vaginant laminae rectangular.

Perichaetia terminal; leaves undifferentiated. *Seta* 2,5 mm long, yellowish; capsules erect, urn short-cylindrical, 0,6 mm long; exothecial cells rectangular, weakly thickened; operculum rostrate, 0,4 mm long; capsules immature, therefore other structures not seen. Fig. 11: 9–17.

Endemic to Southern Africa, *F. aciphyllus* has been collected in forests and woodlands of Transkei, Natal and the Drakensberg of eastern Orange Free State. A specimen from the central Transvaal was collected on rock near water. Map 17.

Vouchers: *Sim* 9940; *Wager* 1446; *Watson* 1582.

Fissidens aciphyllus is identified by its strong limbidia on all laminae, percurrent to short-excurrent costae and very large hexagonal to elongate-hexagonal leaf cells.

3. Section **Semilimbidium**

Semilimbidium *C. Müll.* emend. *Norkett ex Gangulee,* Moss. E. India 454 (1971).

Section *Semilimbidium* C. Müll., Gen. Musc. Fr. 60 (1900).

Plants small; terricolous or corticolous. *Leaves*, or frequently only perichaetial leaves, with limbidia restricted to vaginant laminae. *Laminal cells* small, smooth or mammillose or papillose.

14. **Fissidens submarginatus** *Bruch ex Krauss* in Flora, Jena 29: 133 (1846); Broth. in Natürl. PflFam. 10: 149 (1924); Sim, Bryo. S. Afr. 193 (1926). Type: Natal, *Krauss* s.n. (BM!).

Fissidens opacifolius Mitt., p.p. in Trans. Linn. Soc. Lond. 23: 54 (1860); Broth. in Natürl. PflFam. 10: 149 (1924). Syntypes: Natal, *Gueinzius* s.n., *non* West Africa, *Vogel* s.n. (both NY!).

Fissidens eschowensis Broth. & Bryhn in Forh. Vidensk. Selsk. Krist. 1911 (4): 8 (1911); Broth. in Natürl. PflFam. 10: 149 (1924). Type: Natal, Zululand, Eshowe, *H. Bryhn* s.n., Jan. 1909 (H-BR, holo.!).

Fissidens papillifolius Dix. in Trans. R. Soc. S. Afr. 8: 187 (1920); Broth. in Natürl. PflFam. 10: 149 (1924); Sim, Bryo. S. Afr. 194 (1926). Type: Natal, Albert Falls, Umgeni Nook, *Sim* 8709 (BM, holo.!; PRE!).

Fissidens urceolatus Wag. & Dix. ex Sim, Bryo. S. Afr. 194 (1926). Type: Transvaal, Pretoria, *Wager* 264 (PRE!).

Plants small, forming groups, green to yellow-green; terricolous. *Stems* 3–5 mm long, simple; in section round, central strand present, inner cortical cells large, outer cortical cells in 2 rows, smaller, strongly incrassate. *Leaves* larger above, equally spaced, curved and weakly contorted dry, erect-spreading wet; ligulate or asymmetrically ovate-elliptical, 0,8–1,2 mm long; apex broadly acute to obtuse, cuspidate; margins limbate on vaginant laminae, crenulate by projecting cells on other laminae, limbidia narrow, ending above insertion, marginal throughout; costa strong, short-excurrent. *Vaginant laminae* ± equal, to ¾ of leaf length; dorsal lamina tapering proximally to insertion. *Laminal cells* quadrate to hexagonal, 5–7 μm long, superficially bulging, cells sharply mammillose, rarely with 3–4 low, sharp papillae over lumen.

Autoicous. Perigonia gemmate, axillary. Perichaetia terminal; leaves somewhat larger, little differentiated. *Seta* 2–4 mm long, yellowish; capsule erect to inclined, urn short, cylindrical to elliptical, 0,5–1,0 mm long, yellowish, mouth reddish; exothecial cells quadrate, strongly thickened in corners; peristome cleft to lower ⅓, teeth 0,3 mm long, yellowish red; operculum conical, to 0,7 mm long; spores round, 12–15 μm, granulate. Fig. 12: 1–8.

Fissidens submarginatus is found in eastern and Southern Africa. In the Flora area the species is infrequently collected in northern, central, southern and eastern Transvaal, Swaziland, Zululand, Natal and Transkei. Map 16.

Vouchers: *Magill* 3429, 5069; *Russell* 2644; *Schelpe* 7523; *Smook* 1362; *Van Vuuren* 1737.

The species is identified by the well-developed limbidia on vaginant laminae of all leaves and strongly mammillose leaf cells. This species could easily be confused with sterile specimens of *F. scleromitrius*. The shorter leaves, termination of limbidia above insertion and strongly mammillose cells of *F. submarginatus* should separate the species.

A narrow leaf form, with bulging leaf cells, has been collected in the Transkei. The bulging leaf cells give the plants a different appearance from the more common sharply mammillose specimens; however other character differences were minor. The strong limbidia on vaginant laminae of all leaves should place these specimens.

15. **Fissidens scleromitrius** (*Besch.*) *Broth.* in Natürl. PflFam. 10: 149 (1924). Type: Madagascar.

Conomitrium scleromitrius Besch. in J. Bot., Paris 5: 143 (1891). *Moenkemeyera scleromitria* (Besch.) P. Varde in Arch. Bot. Mém 2: 21 (1930).

Fissidens brevisetus Sim, Bryo. S. Afr. 194 (1926). Type: Natal, New Hanover, *Sim* 9906 (PRE, holo.!).

Plants medium-sized, light green to yellow-green; terricolous. *Stems* 4–6 mm tall, simple; in section subround, central strand present, inner cortical cells thin-walled, outer cortical cells in 1–2 rows, smaller, incrassate. *Leaves* larger above, little contorted dry, erect-spreading wet; oblong-lanceolate to asymmetrically ovate-lingulate, 0,8–1,5 mm long; apex acute to broadly acute; margins crenulate by marginal cell papillae, limbidia on vaginant laminae only, restricted to proximal ⅔ of laminae, broad at insertion, strong on perichaetial and subperichaetial leaves, absent in lower leaves; costa subpercurrent, ending 2–3 cells below apex. *Vaginant laminae* to ⅔ of leaf length, termination of one blade laminal; dorsal lamina tapering proximally or occasionally abruptly rounded below, ending just above insertion. *Upper laminal cells* thin-walled, hexagonal to subhexagonal, 7–10 μm long, superficially bulging, weakly mammillose; basal cells quadrate, smooth.

Dioicous. Perichaetia terminal; leaves lanceolate, to 2,5 mm long. *Seta* very short, 0,6–0,8 mm high, yellowish; capsule erect, urn short-cylindrical, 0,6–0,7 mm long, wide at mouth, yellowish, mouth reddish; exothecial cells short-rectangular, thin-walled, at mouth cells very small, quadrate, in 2–4 rows; peristome not seen; operculum rostrate, 0,8 mm long; spores round, 12 μm, weakly papillose. Fig. 12: 9–15.

Fissidens scleromitrius is known from the East African Islands and Natal. The species is rare, collected in Southern Africa only once by T. R. Sim near New Hanover. Map 14.

Voucher: *Sim* 9906.

When fruiting the species is recognized by its very short seta. The distinct limbidia on proximal vaginant laminae, weakly mammillose leaf cells and oblong-lanceolate leaves, to 1,5 mm long, characterize the species.

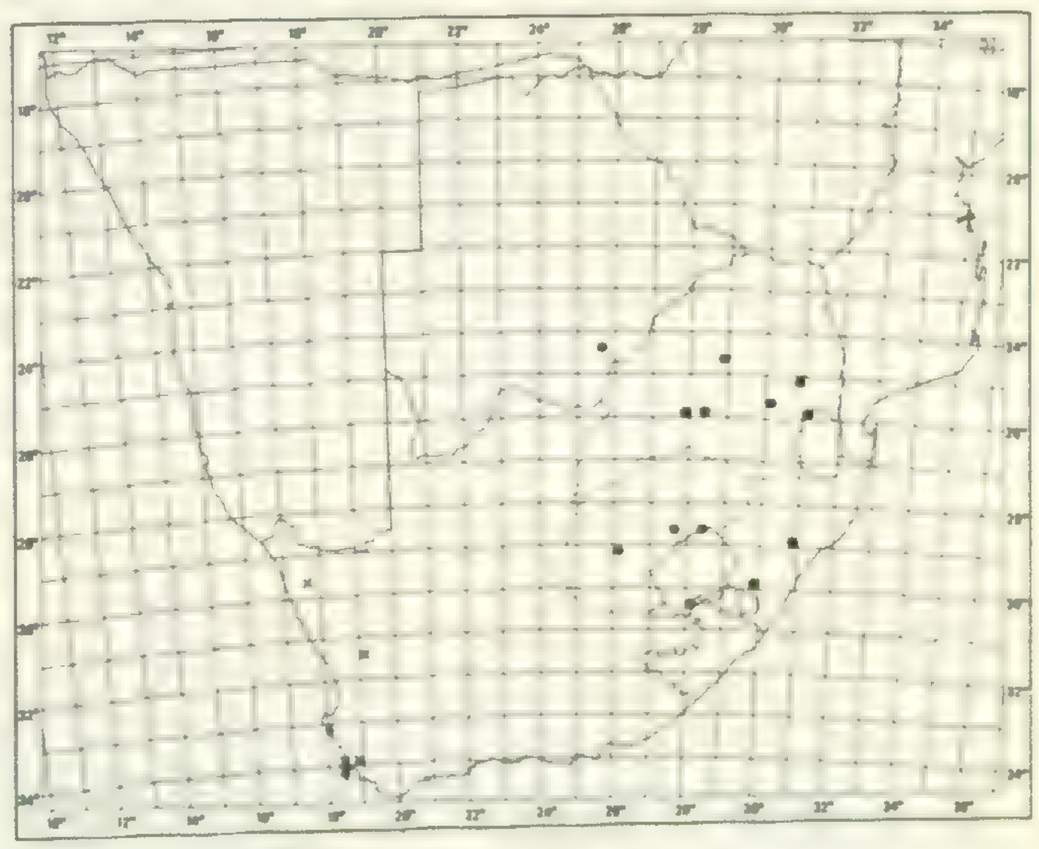
16. **Fissidens microandrogynus** *Dix.* in S. Afr. J. Sci. 18: 306 (1922); Broth. in Natürl. PflFam. 10: 149 (1924). Type: Zimbabwe, Bulawayo, *Wager* 895 (BM, holo.!; PRE!).

Fissidens calochlorus Dix. in S. Afr. J. Sci. 18: 306 (1922); Broth. in Natürl. PflFam. 10: 150 (1924); Sim, Bryo. S. Afr. 189 (1926). Syntypes: Zimbabwe, Victoria Falls, *Sim* 8891 (c.fr.), 8882 (BM!; PRE!).

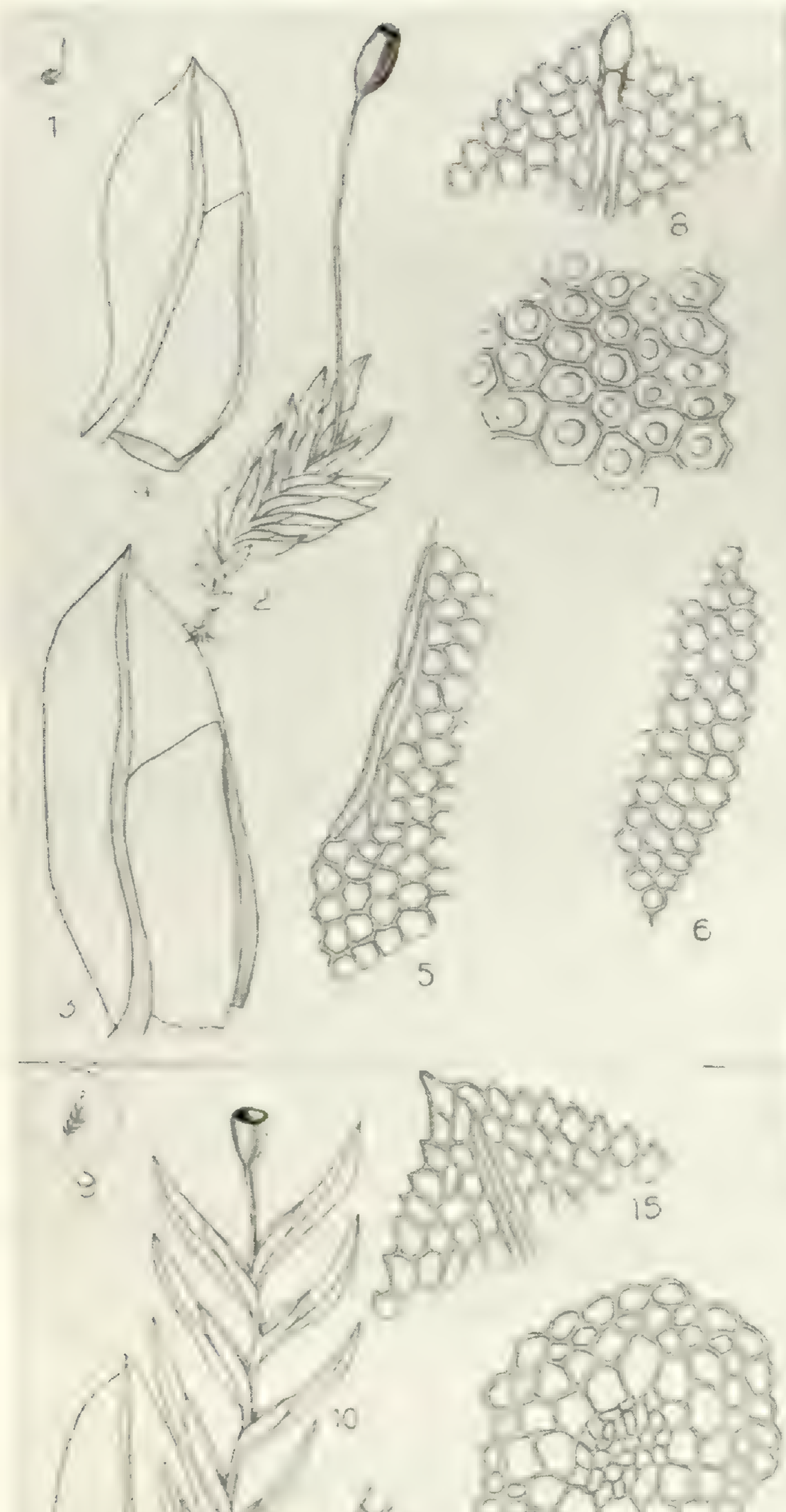
Fissidens hyalobasis Dix. ex Sim, Bryo. S. Afr. 195 (1926). Type: Transvaal, Moorddrift, *Wager* 406 (BM, holo.!; PRE!).

Plants small to medium, in loose groups, dark green to yellow-green; terricolous. *Stems* 3–5 mm long, simple; in section subround, central strand small, inner cortical cells thin-walled, outer cortical cells in 1–2 rows, smaller, incrassate. *Leaves* ± distant, little altered dry; oblong-elliptical to asymmetrically ovate-lingulate, 0,7–1,2 mm long; apex obtuse to rounded in lower and median leaves, frequently acute in upper leaves; margins entire, weakly limbate to elimbate, frequently with only a few differentiated cells on vaginant laminae; costa subpercurrent by 2–4 cells. *Vaginant laminae* to ⅔ of leaf length, termination of one blade laminal; dorsal lamina gradually tapering to insertion, occasionally abruptly rounded at insertion. *Laminal cells* rounded, regularly hexagonal to quadrate, 12–16 μm long, smooth.

Perichaetia terminal; leaves curved, asymmetrically ovate-ligulate, 1,4–1,5 mm long, limbidia on vaginant laminae only. *Seta* 2,0–2,5 mm long, yellowish; capsule erect to inclined, urn short-cylindrical, 0,5–0,6 mm long, yellowish; exothecial cells rectangular, longitudinal walls thickened; peristome deeply cleft, reddish; operculum rostrate; spores round, 12–15 μm, weakly papillose. Fig. 12: 16–21.



MAP 18.— ● **Fissidens microandrogynus**
× **Fissidens pygmaeus**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This species is known from eastern and Southern Africa. In the Flora area it is infrequently collected in Botswana, the eastern and central Transvaal, Natal, Lesotho and the Orange Free State. Map 18.

Vouchers: *Bosman* 1594; *Magill* 4749; *Potts* PRE-CH5126.

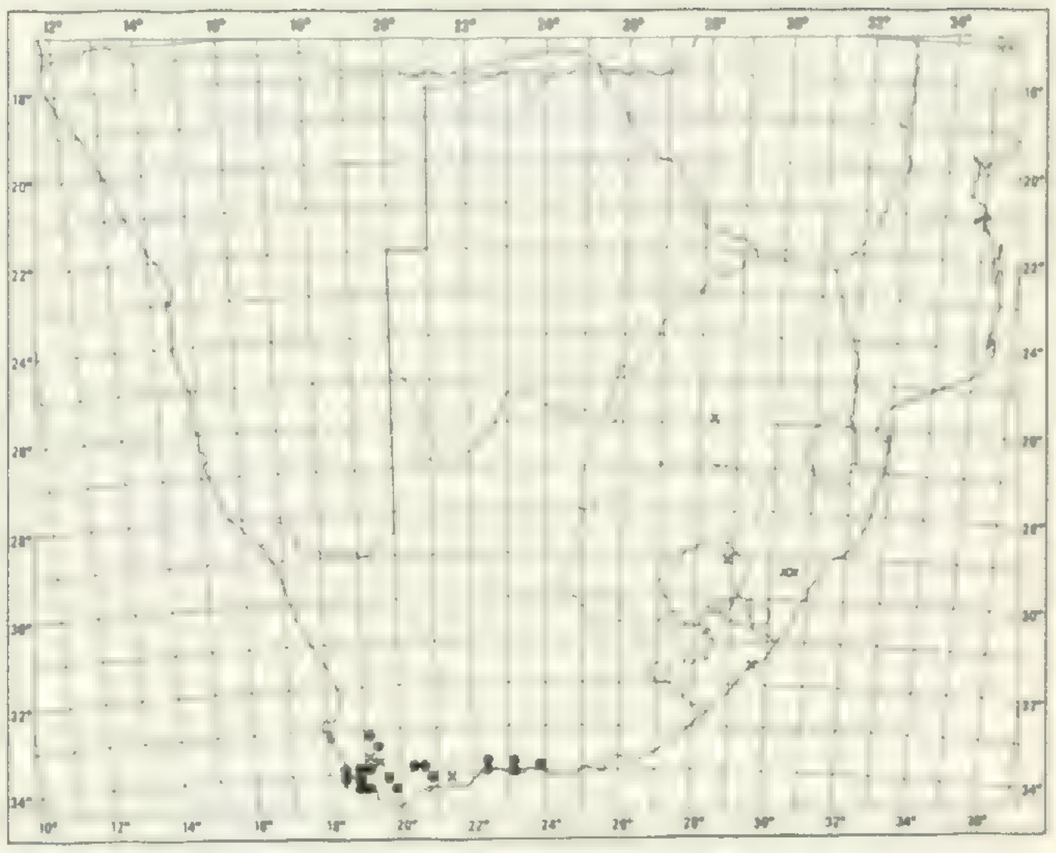
The short, broad leaves, weak limbidia and smooth leaf cells will help to identify this species. *Fissidens microandrogynus* might be confused with *F. parvilimbatus;* larger leaves and smaller leaf cells should separate the former.

17. **Fissidens parvilimbatus** *Sim*, p.p., Bryo. S. Afr. 190 (1926). Syntypes: Natal, New Hanover, *Sim* 9905; Albert Falls, *Sim* 9912 (PRE!); non *Sim* 9915 (PRE!).

Fissidens pectinidens Dix. in Trans. R. Soc. S. Afr. 18: 251 (1930). Type: Transkei, Port St Johns, *Wager* 936 (BM, holo.!; PRE!).

Plants small, scattered or in small groups, light green; terricolous. *Stems* 1–3 mm tall, simple; in section round, central strand small, inner cortical cells lax, outer cortical cells in 1–2 rows, smaller, weakly incrassate. *Leaves* not crowded, little altered dry; lanceolate to elliptical, 0,6–0,8 mm long; apex acute, cuspidate; margins irregular to serrulate, elimbate or occasionally subperichaetial leaves with a few differentiated cells on vaginant laminae; costa percurrent. *Vaginant laminae* to $\frac{2}{3}$ of leaf length, termination of one blade laminal; dorsal lamina gradually tapering proximally to insertion, frequently not reaching stem. *Upper laminal cells* irregularly hexagonal to elongate-hexagonal, 12–17 μm long, smooth; basal cells of vaginant laminae rectangular.

Perichaetia terminal; leaves curved, asymmetrically broadly ovate-lingulate, 1,2 mm long, vaginant laminae limbate. *Seta* to 3 mm long, yellowish; capsule erect, urn short-cylindrical, 0,8 mm long, yellow-brown, reddish at mouth; exothecial cells short-rectangular to quadrate, longitudinal walls thickened; peristome not seen; operculum rostrate; spores round, 22–28 μm, weakly papillose. Fig. 12: 22–28.



MAP 19.— ● **Fissidens fasciculatus**
× **Fissidens parvilimbatus**

Recently reported from Tanzania (Bizot & Pócs, 1979). In Southern Africa the species has been collected in the central Transvaal, Lesotho, Natal, Transkei and the Cape. Map 19.

Voucher: *Bosman* 1611.

The presence of limbidia on the vaginant laminae of perichaetial and subperichaetial leaves, large, smooth leaf cells and rectangular basal leaf cells will identify *F. parvilimbatus*. This species is similar to *F. microandrogynus;* see note under that species.

18. **Fissidens pygmaeus** *Hornsch.* in Linnaea 15: 147 (1841); Broth. in Natürl. PflFam. 10: 148 (1924). Type: Cape, Table Mountain, *Ecklon* s.n. (H-BR!).

Fissidens bifrons Schimp. ex C. Müll. in Bot. Ztg 17: 198 (1859); Broth. in Natürl. PflFam. 10: 148 (1924); Sim, Bryo. S. Afr. 189 (1926). Type: Cape, Green Kloof, *Breutel* s.n. (BM!).

Fissidens perpaucifolius Dix. ex Sim in Trans. R. Soc. S. Afr. 15: 196 (1926). Type: Cape, Stellenbosch, *Wager* 647 (BM, holo.!; PRE!).

Plants very small, scattered, yellow-green; terricolous. *Stems* to 4 mm high in sterile plants, in fertile plants generally less than 1 mm high, simple; in section elliptical, central strand present, cortical cells in 2–3 rows, small, thickened. *Leaves* crowded in fertile plants, distant in sterile plants, little altered

FIG. 12.—**Fissidens submarginatus** (1–8): **1.** habit, ×1; **2.** habit, ×10; **3–4.** leaves, ×35; **5.** cells at lower margin of vaginant lamina, ×435; **6.** cells at lower margin of dorsal lamina, ×435; **7.** upper laminal cells at margin, ×640; **8.** leaf apex, ×435. **F. scleromitrius** (9–15): **9.** habit, ×1; **10.** habit, ×10; **11.** stem in cross section, ×230; **12.** leaf, ×35; **13.** cells at lower margin of vaginant lamina, ×435; **14.** cells at margin of dorsal lamina, ×640; **15.** leaf apex, ×435. **F. microandrogynus** (16–21): **16.** habit, ×1; **17.** habit, ×10; **18.** leaf, ×35; **19.** leaf base, ×170; **20.** cells at margin of dorsal lamina, ×640; **21.** leaf apex, ×170. **F. parvilimbatus** (22–28): **22.** habit, ×1; **23.** habit, ×10; **24–25.** leaves, ×35; **26.** leaf base, ×435; **27.** upper laminal cells, ×640; **28.** leaf apex, ×435. (1–8, *Magill* 5421; 9–15, *Sim* 9906; 16–21, *Wager* 79; 22–28, *Sim* 9905).

dry; asymmetrically broadly ovate to ligulate, 0,3–0,5 mm long; apex acute, generally bent downwards in sterile plants; margins entire, elimbate in lower leaves, limbate by 1–4 rows of elongate cells on vaginant laminae of subperichaetial leaves; costa strong, percurrent to very short-excurrent. *Vaginant laminae* extending to upper leaf, termination of one blade costal; dorsal lamina very narrow or bulging distally in leaves of fertile plants, ending well above insertion. *Laminal cells* quadrate to short-rectangular, 10–15 μm long, smooth, flat.

Perichaetia terminal; leaves asymmetrical, broadly ovate, acuminate, to 1 mm long, vaginant laminae distinctly limbate. *Seta* 3–7 mm long, yellowish; capsule erect to inclined, urn short-cylindrical, 0,6–0,8 mm long, yellowish, mouth reddish; exothecial cells quadrate, longitudinal walls thickened; peristome deeply cleft, reddish; operculum short-rostrate, 0,3 mm long; spores round, 22–25 μm , weakly papillose. Fig. 14: 1–9.

Endemic to Southern Africa, *F. pygmaeus* is found in the northwestern and southwestern Cape Province. Map 18.

Vouchers: *Magill & Schelpe* 3936, 3961; *Rehmann* 295, 585; *Schelpe* 7731.

Sim (1926) was incorrect in his inclusion of *F. pygmaeus* (=*F. bifrons*) in the synonomy of *F. splachnifolius*. The latter is a very distinctive species, belonging to the section *Areofissidens*, and has been rarely collected. *Fissidens pygmaeus* is a more common species of the section *Semilimbidium*.

Fissidens pygmaeus exhibits two distinct growth-forms, i.e. elongate sterile plants with distant leaves and short fertile plants with only a few broad, crowded leaves. Most collections contain both sterile and fertile plants.

Although direct contact between sterile and fertile stems has not been observed, leaf shape, anatomy and laminal cell size and pattern illustrate the relationship between the two growth-forms. One distinctive character of the sterile plants is the reflexed leaf apices. This character was also observed on some of the small basal leaves of fertile plants, although it was generally less pronounced.

19. **Fissidens borgenii** *Hampe* in Bot. Ztg 28: 36 (1870); Broth. in Natürl. PflFam. 10: 151 (1924). Type: Natal, Umpumulo, *Borgen* s.n., 1867 (BM, holo.!; MANCH!).

Fissidens linearicaulis Broth. & Bryhn in Forh. Vidensk Selsk. Krist. 1911 (4): 9 (1911); Broth. in Natürl. PflFam. 10: 149 (1924). Type: Natal, Ekombe, *Titlestad* s.n., Nov. 1907 (H-BR, holo.!).

Fissidens haakonii Broth. & Bryhn in Forh. Vidensk Selsk. Krist. 1911 (4): 10 (1911); Broth. in Natürl. PflFam. 10: 151 (1924). Type: Natal, Eshowe, *H. Bryhn* s.n., Apr. 1908 (H-BR, holo.!).

Plants small, forming groups, yellow-green to green; corticolous or rarely saxicolous. *Stems* 2–3 mm tall, simple; in section subround, central strand present, inner cortical cells large, in 2 rows, outer cortical cells in 2–3 rows, stereids or substereids. *Leaves* larger above, apically recurved dry, erect wet; ligulate to asymmetrically oval-lingulate, 0,9–1,4 mm long; apex acute to broadly acute; margins minutely crenulate by marginal cell papillae, elimbate or subperichaetial leaves limbate on vaginant laminae only; costa percurrent or ending just below apex. *Vaginant laminae* to mid-leaf or just above, termination of one blade submarginal to laminal; dorsal lamina tapering proximally, abruptly rounded at insertion. *Laminal cells* hexagonal to quadrate, 5–10 μm long, obscured by numerous, low, dense, peripheral papillae.

Perichaetia terminal; leaves 1,5 mm long, limbidia on vaginant laminae only, laminal cells elongate to rectangular, smooth. *Seta* 1–2 mm long, yellow; capsule erect to inclining, urn short-cylindrical, 0,5–0,8 mm long, strongly constricted below mouth when dry, yellowish; exothecial cells quadrate, longitudinal walls thickened; peristome deeply cleft, reddish; operculum rostrate; spores round, 10–12 μm, weakly papillose. Fig. 14: 10–16.

Known from southeastern and Southern Africa, *F. borgenii* is infrequently collected in dry woodlands of the northern and eastern Transvaal, Zululand, Natal, Transkei and the southwestern Cape. Map 15.

Vouchers: *Magill* 5222, 6164; *Smook* 1365; *Van Rooy* 238; *Von Breitenbach* 220.

A distinctive species, *F. borgenii* is identified by its acute apices, variable, weak limbidia restricted to the vaginant laminae of perichaetial and subperichaetial leaves, percurrent to short-excurrent costa and low, dense papillae that obscure the leaf cells. *Fissidens borgenii* is closely related to *F. subobtusatus* and *F. erosulus*. In addition to the above characters, preference of rough-bark substrates will help to identify *F. borgenii*.

20. **Fissidens erosulus** (*C. Müll.*) *Par.*, Ind. Bryol. 467 (1896); Broth. in Natürl. PflFam. 10: 151 (1924); Sim, Bryo. S. Afr. 191 (1926). Type: Central Africa, Niam-Niam Region, Nabambisso, *Schweinfurth* s.n., 17 Feb. 1870 (BM!).

Conomitrium erosulum C. Müll. in Linnaea 39: 367 (1875).

Plants small, in groups, yellow-green to dark green; terricolous. *Stems* (2–) 4–6 mm tall, simple; in section round, central strand present, inner cortical cells large, in single row, outer cortical cells in 1–2 rows, smaller, incrassate. *Leaves* crisped or twisted dry, erect wet; ligulate to lingulate, somewhat asymmetrical, 0,8–1,4 mm long; apex acute; margins crenulate to serrulate by projecting cells, elimbate or with weak limbidia on vaginant laminae only, limbidia frequently consisting of only a few elongated, smooth cells; costa percurrent or ending just below apex. *Vaginant laminae* extending to ¾ of leaf length, termination of one blade laminal; dorsal lamina gradually tapering to insertion. *Laminal cells* hexagonal to quadrate, 5–7 μm long, frequently bulging with 4–6 low, simple papillae over lumen, not obscuring cells, occasionally cells almost smooth.

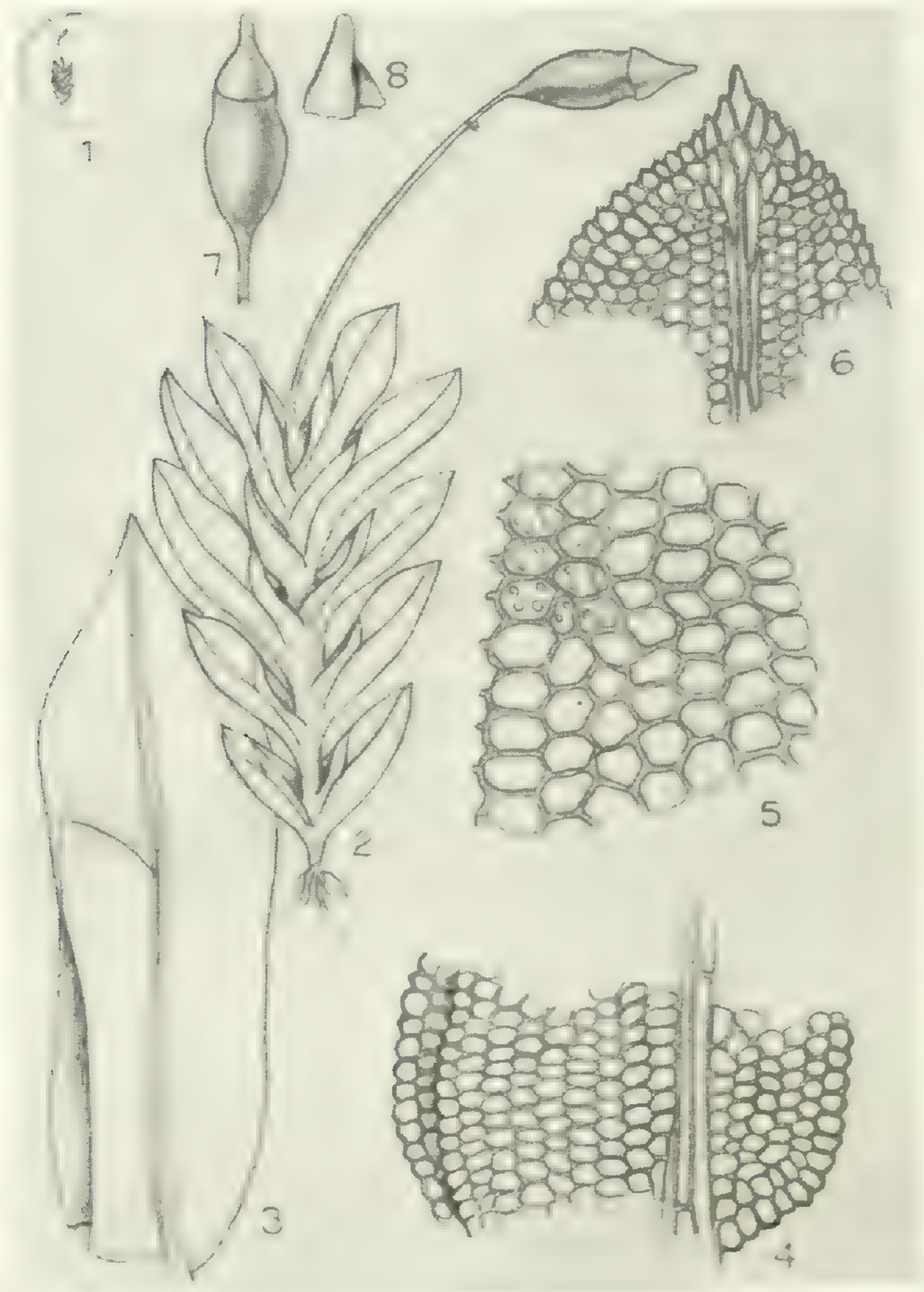


FIG. 13.—**Fissidens erosulus: 1.** habit, ×1; **2.** habit, ×10; **3.** leaf, ×40; **4.** leaf base, ×170; **5.** upper laminal cells (papillae partly shown), ×640; **6.** leaf apex, ×170; **7.** capsule, ×15; **8.** calyptra, ×15. (1–8, *Taylor* 462).

Perichaetia terminal; leaves somewhat asymmetrical, lanceolate, 1,5 mm long, vaginant laminae limbate. *Seta* 2,5 mm long, yellowish; capsule inclined, urn short-cylindrical, 0,5–0,6 mm long; exothecial cells quadrate, longitudinal walls thickened; peristome reddish yellow, deeply cleft; operculum rostrate; spores round, 10–12 μm, spiculate. Fig. 13: 1–8.

Fissidens erosulus is known from central, eastern and Southern Africa. In the Flora area it occurs in northern Botswana, the northern, central and eastern Transvaal, Swaziland and Zululand. Map 7.

Vouchers: *Cholnoky* 445; *Magill* 3592, 4984, 5366; *Taylor* 462; *Van Rooy* 216.

This species is very closely related to *F. borgenii*. The two species can only be separated by leaf cell ornamentation and substrate preferences. The connection between substrate and papillae development requires further study before the relationship between these two species can be properly assessed.

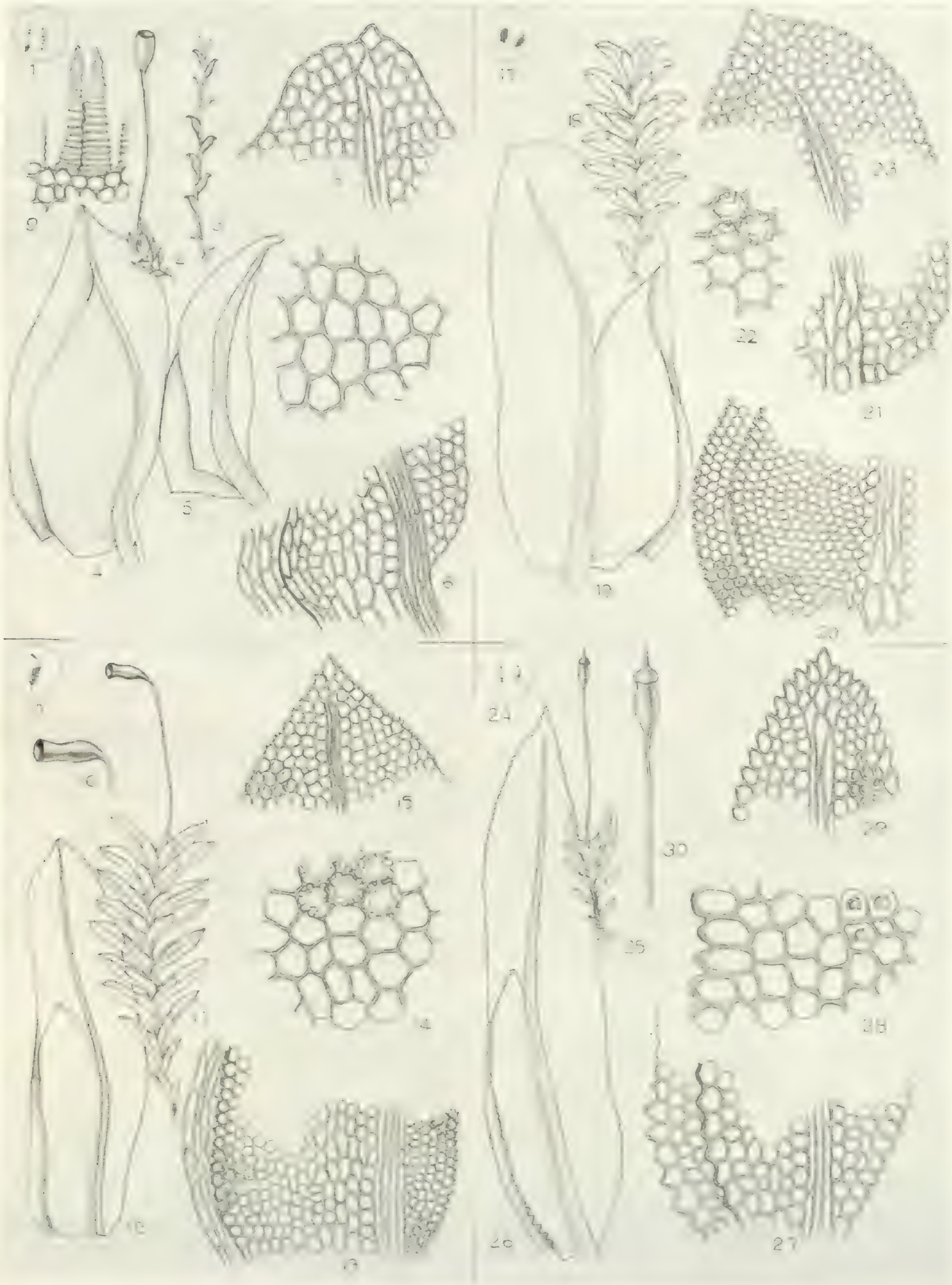
The type specimen of *F. erosulus* has mammillose upper lamina cells, but the basal leaf cells have several low, papillae over each lumen. This corresponds with several of the Zimbabwe specimens that were examined. The cells of the Southern African specimens are occasionally weakly bulging and have 4–6 low, simple papillae in a central 'ring' over each lumen. Unlike the peripheral papillae of *F. borgenii*, these papillae do not obscure the leaf cells.

21. **Fissidens subobtusatus** *C. Müll.* in Hedwigia 38: 56 (1899); Broth. in Natürl. PflFam. 10: 151 (1924). Type: Transvaal, Lake Chrissie, *Wilms* s.n., Apr. 1885, in herb. Jack (G. holo.!).

Fissidens borgenii Hampe var. *obtusifolius* Dix. in Trans. R. Soc. S. Afr. 8: 187 (1920); Sim, Bryo. S. Afr. 192 (1926). Type: Natal, Van Reenen, *Wager* 166 (PRE!).

Plants small, forming loose groups, light green; terricolous. *Stems* 2–3 mm long, simple; in section subround, central strand present, inner cortical cells in 3 rows, small, outer cortical cells in 2 rows, stereids or substereids. *Leaves* larger above, contorted dry, erect-spreading wet; ligulate to lingulate, 0,4–0,7 mm long; apex broadly acute, obtuse or rounded, abruptly apiculate by a smooth clear cell; margins elimbate, crenulate; costa ending 6–8 cells below apex. *Vaginant laminae* extending to mid-leaf or just above, termination of one blade laminal; dorsal lamina gradually tapering to insertion. *Laminal cells* quadrate to hexagonal, 6–8 μm long, with 4–6 low, blunt papillae over lumen.

Perichaetia terminal; leaves ligulate, to 1 mm long, vaginant laminae limbate with a



few elongate, smooth cells on margin. *Seta* 2,0–2,5 mm long, dark yellow; capsule inclined, urn short-cylindrical, 0,8 mm long, reddish yellow; exothecial cells quadrate, longitudinal walls strongly thickened; peristome deeply cleft, red-yellow; operculum rostrate, beak ± oblique; calyptra cucullate; spores round, 12–16 μm, very weakly papillose, green. Fig. 14: 17–23.

F. subobtusatus is found in grasslands of the Transkei, northeastern Orange Free State, central and eastern Transvaal and central South West Africa/Namibia. It has also been reported from east Africa (Bizot & Pócs, 1979). Map 20.

Vouchers: *Magill* 3005; *Scott* 11135; *Van Vuuren* 1698.

Close to *F. borgenii* but differing in the smaller size of the plants, shorter leaves with rounded apices and the costa ending below the apex. In addition, *F. subobtusatus* grows on soil and dolomite rock.

4. Section **Crenularia**

Crenularia *C. Müll.* emend. *Norkett ex Gangulee*, Moss. E. India 456 (1971).

Section *Crenularia* C. Müll., Gen. Musc. Fr. 62 (1900).

Plants small; corticolous. *Leaves* without limbidia. *Laminal cells* small, papillose or mammillose.

22. **Fissidens pseudoserratus** (*C. Müll.*) *Jaeg.*, Enum. Fissid. 24 (1869); Broth. in Natürl. PflFam. 10: 151 (1924); Sim, Bryo. S. Afr. 190 (1926). Type: Cape, Krakakamma, *Ecklon* s.n., July 1852 (BM!).

Conomitrium pseudoserratum C. Müll. in Bot. Ztg 17: 197 (1859).

Plants small, scattered or in loose patches, light green; corticolous or rarely saxicolous. *Stems* 1,0–1,5 mm tall, simple; in section subround, central strand very small, inner cortical cells in 1–2 rows, large, outer cortical cells in 1–2 rows, small, incrassate. *Leaves* flattened, with recurved apices dry, erect-spreading wet; lanceolate, 0,6–0,9 mm long; apex acute; margins elimbate, serrate, frequently dentate on vaginant laminae; costa strong, percurrent. *Vaginant laminae* extending to mid-leaf, termination of one blade laminal; dorsal lamina tapering proximally, just reaching insertion. *Laminal cells* hexagonal to angular, 6–12μm long, thickened, weakly bulging to sharply mammillose.

Perichaetia terminal; leaves undifferentiated. *Seta* 2 mm long, yellow; capsule erect, urn short-cylindrical, 0,3–0,5 mm long, yellowish; exothecial cells quadrate, bulging,

MAP 20.— ● **Fissidens pseudoserratus**
× **Fissidens subobtusatus**

FIG. 14.—**Fissidens pygmaeus** (1–9): **1.** habit, ×1; **2.** fertile plant, ×10; **3.** sterile plant, ×10; **4.** leaf from fertile plant, ×100; **5.** leaf from sterile plant, ×100; **6.** leaf base, ×435; **7.** upper laminal cells, ×640; **8.** leaf apex, ×435; **9.** part of capsule mouth with peristome teeth, ×170. **F. borgenii** (10–16): **10.** habit, ×1; **11.** habit, ×10; **12.** leaf, ×30; **13.** leaf base, ×435; **14.** upper laminal cells (papillae partly shown), ×640; **15.** leaf apex, ×435; **16.** capsule, ×20. **F. subobtusatus** (17–23): **17.** habit, ×1; **18.** habit, ×10; **19.** leaf, ×75; **20.** cells at base of vaginant laminae, ×435; **21.** cells at base of dorsal lamina, ×435; **22.** upper laminal cells (papillae partly shown), ×640; **23.** leaf apex, ×435. **F. pseudoserratus** (24–30): **24.** habit, ×1; **25.** habit, ×10; **26.** leaf, ×100; **27.** leaf base, ×435; **28.** upper laminal cells at margin, ×640; **29.** leaf apex, ×435; **30.** capsule, ×20, (1, 3, 5, 9, *Breutel* s.n.; 2, 4 & 6–8, *Ecklon* s.n.; 10–16, *Van Rooy* 98; 17–23, *Van Vuuren* 1698; 24–25 & 30. *Schelpe* 4407; 26–29, *Sim* PRE-CH5096).

thin-walled; peristome deeply cleft, reddish; spores round, 12–14 μm, weakly papillose. Fig. 14: 24–30.

Endemic to Southern Africa, the species occurs in grasslands and woodlands of the central Transvaal, Zululand, Natal and eastern Cape. Map 20.

Vouchers: *Crosby* 7785; *Magill* 3125, 5571; *Schelpe* 4407.

The small plants with narrow, elimbate leaves, strongly serrate margins and mammillose leaf cells will identify *F. pseudoserratus*. The species is quite distinct and is the only representative of section *Crenularia* in Southern Africa.

5. Section **Aloma**

Aloma *C. Müll.*, Gen. Musc. Fr. 61 (1900).

Plants small; terricolous. *Leaves* without limbidia; costa percurrent to short-excurrent. *Laminal cells* smooth to convex.

23. **Fissidens nitens** *Rehm. ex Salm.* in Ann. Bot. 13: 121 (1899); Broth. in Natürl. PflFam. 10: 149 (1924); Sim, Bryo. S. Afr. 192 (1926). Type: Natal, Inanda, *Rehmann* 289 (BM!).

Plants small, in loose groups, yellow-green, glossy; semi-aquatic. *Stems* 3–4 mm tall, simple; in section elliptical, central strand absent, inner cortical cells large, outer cortical cells large, 2–3 rows, smaller, incrassate or sub-stereids. *Leaves* equally spaced, little altered dry, erect-spreading wet; broadly lanceolate to ovate-lingulate, 1,0–1,2 mm long; apex acute; margins bistratose; in section forming 4-celled, club-shaped border, minutely serrulate above, marginal cells similar to laminal cells; costa subpercurrent. *Vaginant laminae* extending to mid-leaf, termination of one blade laminal; dorsal lamina very gradually tapering proximally to abruptly rounded at base. *Laminal cells* hexagonal to subhexagonal, 12–15 μm long, incrassate, smooth; basal cells undifferentiated.

Sporophyte not known. Fig. 11: 24–30.

In Southern Africa, specimens of *F. nitens* have been collected in or near running water in Natal and Zululand. The species was recently reported from east Africa by Bizot & Pócs (1979). Map 17.

Voucher: *Van der Plank* 240.

The bistratose margins of this species are obvious in specimens mounted in Hoyer's medium. Water-mounted specimens generally exhibit a darker margin.

Since the marginal cells of *F. nitens* are not differentiated from the laminal cells, the bistratose margin is not interpreted as a true limbidium. The species is therefore placed into section *Aloma*.

6. Section **Crispidum**

Crispidum *C. Müll.* emend. *Norkett ex Gangulee*, Moss. E. India 457 (1971).

Section *Crispidum* C. Müll., Gen. Musc. Fr. 64 (1900).

Plants medium to large; terricolous. *Stems* with axillary hyaline nodules between vaginant laminae. *Leaves* without limbidia, margins often crenulate. *Laminal cells* rounded, incrassate, frequently mammillose.

24. **Fissidens glaucescens** *Hornsch.* in Linnaea 15: 154 (1841); Broth. in Natürl. PflFam. 10: 151 (1924); Sim, Bryo. S. Afr. 201 (1926). Type: Cape, Table Mountain, *Ecklon* s.n. (H-BR!).

Fissidens mucronatus Schimp. ex C. Müll. in Bot. Ztg 16: 154 (1858). Type: Cape, Bethal, *Breutel* s.n. (BM, holo.!).

Fissidens lanceolatus Hampe in Bot. Ztg 28: 36 (1870); Broth. in Natürl. PflFam. 10: 151 (1924). Type: Natal, Mapumulo, *Borgen* s.n., Jan. 1867 (BM, holo.!).

Fissidens cymatophyllus C. Müll. in Linnaea 42: 238 (1879); Bizot in Bull. Soc. bot. Fr. 114: 423 (1967). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1878 (GRA!).

Fissidens rehmannii C. Müll. in Hedwigia 38: 56 (1899); Broth. in Natürl. PflFam. 10: 151 (1924). Type: Natal, Inanda, *Rehmann* 282d (NH!).

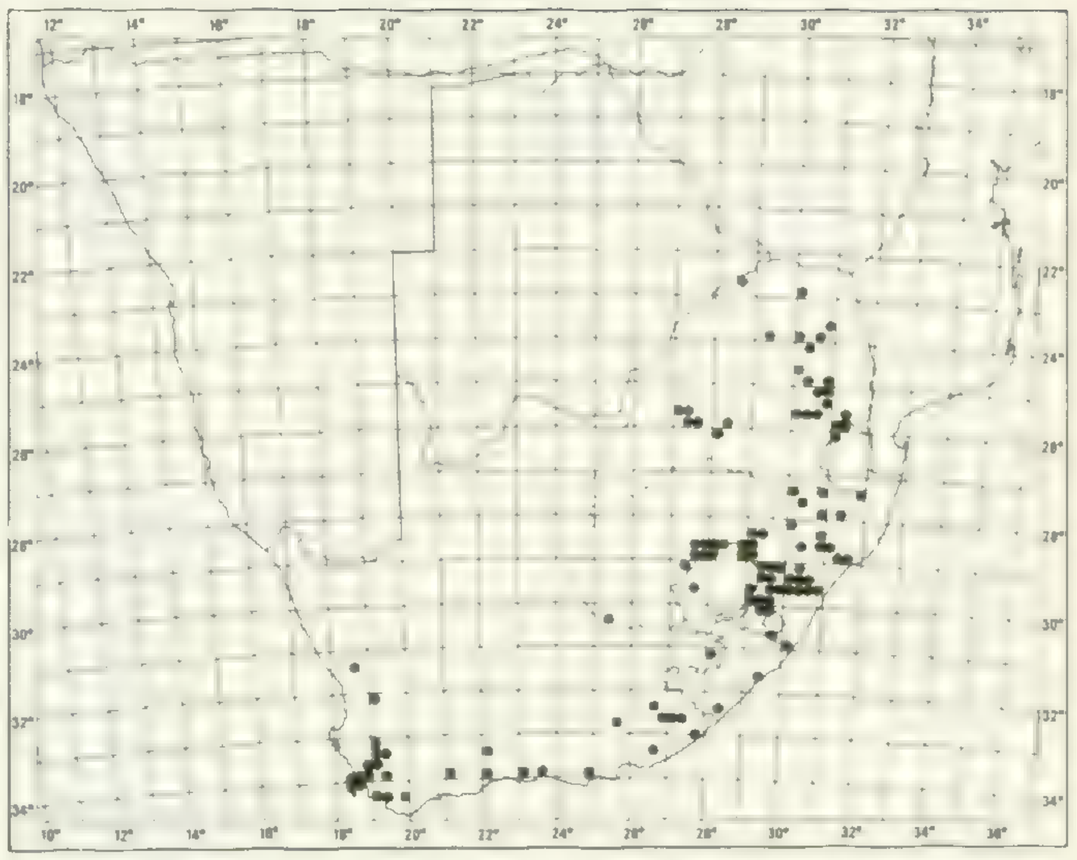
Fissidens procerior Broth. & Bryhn in Forh. Vidensk Selsk. Krist. 1911: 9 (1911). Type: Natal, Entumeni, *H. Bryhn* s.n., Apr. 1908 (H-BR!).

Fissidens zuluensis Broth. & Bryhn in Forh. Vidensk Selsk. Krist. 1911: 9 (1911). Type: Natal, Entumeni, *H. Bryhn* s.n., Apr. 1908 (H-BR!).

Plants large, in loose groups, light green; terricolous, frequently semi-aquatic. *Stems* 5–10 mm long, occasionally branched; in section elliptical, central strand present, inner cortical cells large, in 3 (4) rows, outer cortical cells stereids, in 3 rows, reddish; axillary hyaline nodules numerous, of 6–10 enlarged, clear or chlorophyllous cells, enclosed by vaginant laminae. *Leaves* equally spaced, erect with circinate tips dry, erect-spreading wet, occasionally somewhat undulate; oblong to oblong-lanceolate, 2,0–3,2 mm long; apex obtuse to broadly acute, cuspidate; margins elimbate, entire to serrulate, frequently serrate at apex; costa strong, short-excurrent, flexuous above. *Vaginant laminae* ⅔ of leaf length, termination of one blade submarginal or laminal; dorsal lamina not narrowing toward stem, rounded proximally, generally crumpled against stem. *Upper laminal cells* rounded-hexagonal, 8–12 μm long, incrassate, mammillose; quadrate marginally, smooth; cells of vaginant laminae quadrate to rectangular, smooth, becoming smaller toward margin.

Dioicous. Perigonia axillary, gemmate. Perichaetia terminal or infrequently axillary; leaves not differentiated. *Seta* to 10 mm long, reddish yellow; capsule horizontal, urn curved, 1,2–1,5 mm long, red-yellow; exothecial cells rectangular, incrassate; peristome teeth deeply cleft, red-yellow; operculum conic-rostrate, 0,6 mm high; spores round, 15–20 μm, smooth. Fig. 15: 1–6.

The species is known from eastern and Southern Africa. It is the most widely distributed species of *Fissidens* in the Flora area and occurs in grassland and woodland of the northern, eastern, central and southern Transvaal, Swaziland, Zululand, Natal, Lesotho, Orange Free State, Transkei and the eastern, central, southern and western Cape. Map 21.



MAP 21.— ● **Fissidens glaucescens**

Vouchers: *Cholnoky* 410; *Esterhuysen* 24, 444; *Magill* 3085, 4763, 5622; *Schelpe* 2033; *Van Rooy* 84.

The large size of the plants, leaf shape and small, incrassate, mammillose leaf cells will separate specimens of *F. glaucescens*. The species is similar to *F. asplenioides*, but the two species are easily divided by the shape of their leaf apices, costal development and morphology of the dorsal laminae. Intermediates between the two species were not seen.

F. glaucescens is included in section *Crispidium* because of the axillary hyaline nodules regularly produced on the stem between the vaginant laminae. Occasionally meristematic activity was observed in these structures, resulting in the development of perichaetial or perigonial buds; vide Iwatsuki & Pursell, 1980.

7. Section **Serridium**

Serridium *C. Müll.* emend. *Norkett ex Gangulee*, Moss. E. India 457 (1971).

Section *Serridium* C. Müll., Gen. Musc. Fr. 67 (1900).

Plants large to robust; terricolous. *Stems* without axillary hyaline nodules. *Leaves* without limbidia, marginal cells occasionally weakly differentiated. *Laminal cells* rounded, incrassate, generally mammillose.

25. **Fissidens plumosus** *Hornsch.* in Linnaea 15: 151 (1841); Broth. in Natürl. PflFam. 10: 151 (1924); Sim, Bryo. S. Afr. 203 (1926). Type: Cape, Vorgebirge, *Mundt & Maire* s.n.

Plants large, in small groups; terricolous or saxicolous. *Stems* 5–7 mm long, unbranched; in section elliptical, central strand present, inner cortical cells in 2–3 rows, large, incrassate, outer cells in 2–3 rows, stereids. *Leaves* crowded, recurved to secund wet or dry; linear, (2–)3–5 mm long; apex acute; margins elimbate, smooth below, crenulate to serrate above; costa percurrent to mucronate. *Vaginant laminae* ½ of leaf length, termination

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of one blade marginal to submarginal; dorsal lamina tapering proximally, generally not reaching stem, if so, decurrent by single row of cells. *Upper laminal cells* rounded, mixture of large (12–20 μm long) and small (7–10 μm long) cells, quadrate to short-rectangular, strongly incrassate, weakly mammillose to smooth; cells of vaginant laminae similar but becoming smaller toward margin.

Dioicous. Perichaetia terminal; leaves undifferentiated. *Seta* 8–9 mm long, yellow-brown, bent upward from prostrate stem; capsule horizontal, urn oval, 1 mm long, reddish yellow; exothecial cells rectangular, incrassate; peristome teeth cleft to middle, reddish yellow; operculum conic-rostrate, to 0,5 mm long; spores round, 12–13 μm, spiculate. Fig. 15: 7–12.

Endemic to Southern Africa, *F. plumosus* is frequently collected on shaded banks in forests and fynbos of the southern and southwestern Cape. A few collections have also been made in the northwestern and eastern Cape, Natal and the central, eastern and northern Transvaal. Map 22.

Vouchers: *Esterhuysen* 26903; *Magill* 6192; *Smook & Phelan* 839; *Schelpe* 7856.

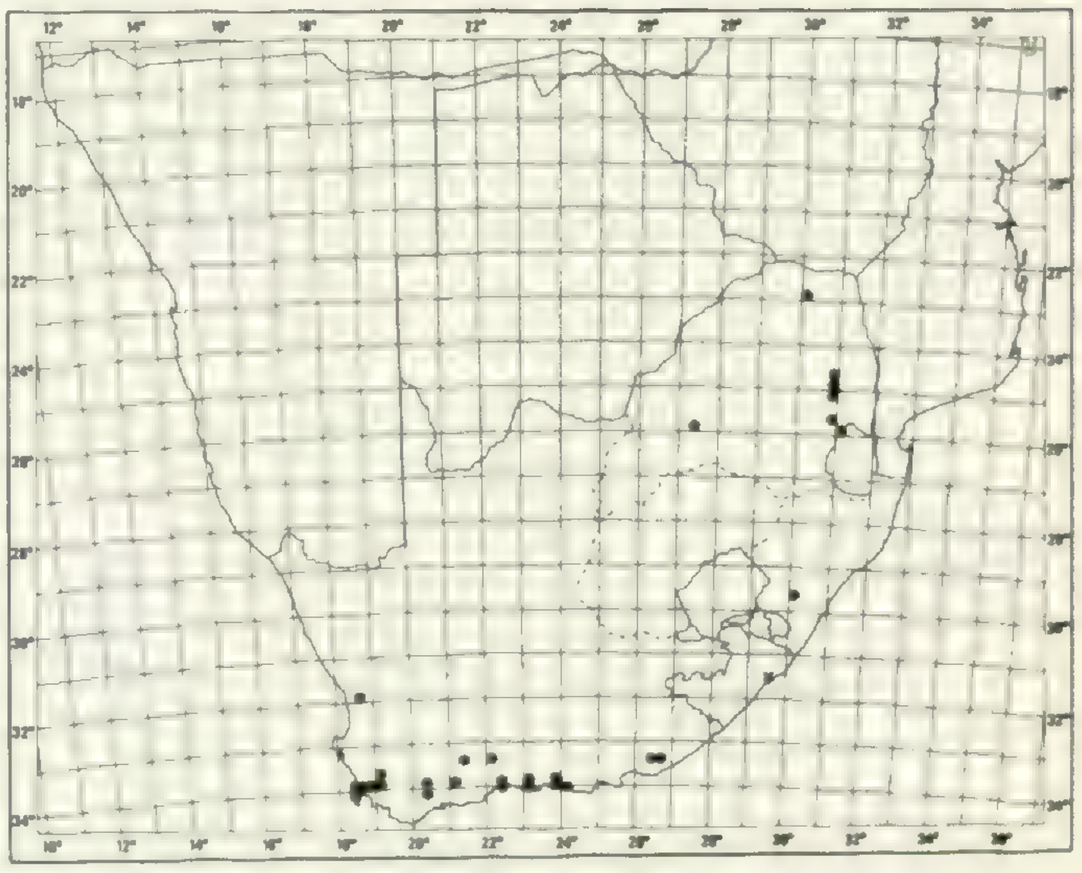
The habit, narrow leaves and large, flat leaf cells should identify this species. The development of the dorsal lamina is useful in separating the species from *F. glaucescens*.

Some confusion between *F. plumosus* and *F. fasciculatus* has been noted on earlier collections. The habit and leaf shape of the two species are quite similar, but *F. plumosus* is a much shorter plant and its leaves are unistratose throughout.

26. **Fissidens asplenioides** *Hedw.*, Spec. Musc. 156 (1801); Broth. in Natürl. PflFam. 10: 151 (1924); Grout in N. Amer. Fl. 15, 3: 192 (1943). Type: Jamaica, s. coll. (G, holo.!).

Fissidens amblyophyllus C. Müll. in Hedwigia 38: 57 (1899); Broth. in Natürl. PflFam. 10: 151 (1924); Sim, Bryo. S. Afr. 203 (1926). Syntypes: Natal, Van Reenens Pass, *Rehmann* 285b (PRE!); Inanda, *Rehmann* 285 (PRE!); Transvaal, Spitzkop, *Wilms* s.n., 1887 (G!).

Plants large, forming turfs or groups, yellow-green to light green; terricolous. *Stems* 10–15 mm tall, infrequently branched; in section subround, central strand small, inner cortical cells large, in 3 rows smaller toward



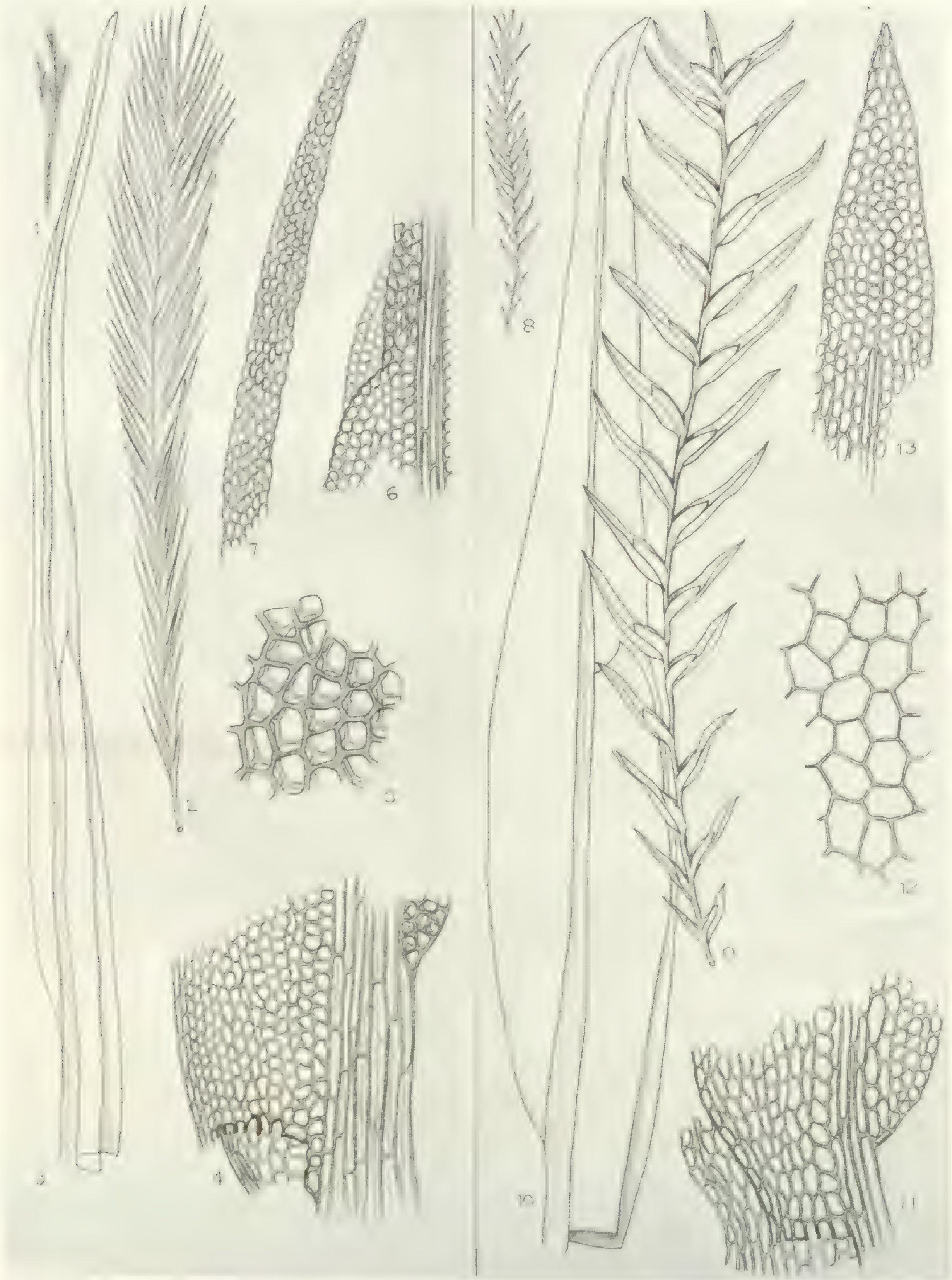
MAP 22.—● **Fissidens plumosus**
× **Nanobryum dummeri**

margin, outer cortical cells in 2 rows, stereids, red-yellow. *Leaves* somewhat crowded, erect with circinate apices dry, patent wet; ligulate to oblong-lanceolate, 2–3 mm long; apex obtuse to rounded, rarely broadly acute; margins elimbate, crenulate; costa ending below apex, flexuose above. *Vaginant laminae* to ⅔ leaf length, one blade abruptly rounded distally, terminating on lamina or costa; dorsal lamina abruptly rounded near insertion. *Laminal cells* rounded, hexagonal to subhexagonal, 8–10 μm long, incrassate, superficially bulging; slightly larger in vaginant laminae.

Perichaetia terminal or lateral; leaves undifferentiated. *Seta* 3–5 mm long; capsule erect, urn short-cylindrical, 0,5–1,0 mm long; peristome deeply cleft, reddish; operculum long-rostrate; spores not seen. Fig. 15: 13–18.

Fissidens asplenioides is widely distributed, especially in the Southern Hemisphere. The species is known from Central and South America, Africa, India, southeast Asia, Australia and New Zealand. In Southern Africa, the species is found in grassland and woodland communities of the northern, central and eastern Transvaal, Zululand, Natal, northeastern Orange Free State as well as the eastern and southern Cape. Map 10.

FIG. 15.—**Fissidens glaucescens** (1–6): **1.** habit, ×1; **2.** habit, ×6; **3.** leaf, ×50; **4.** leaf base, ×170; **5.** leaf apex, ×170; **6.** upper laminal cells, ×640. **F. plumosus** (7–12): **7.** habit, ×1; **8.** habit, ×6; **9.** leaf, ×50; **10.** leaf base, ×170; **11.** leaf apex, ×170; **12.** upper laminal cells, ×640. **F. asplenioides** (13–18): **13.** habit, ×1; **14.** habit, ×6; **15.** leaf, ×50; **16.** leaf base, ×170; **17.** leaf apex, ×170; **18.** upper laminal cells, ×640. (1–6, *Cholnoky* 410; 7–8, *Schelpe* 7856; 9–12, *Magill* 6032; 13–18, *Magill* 3054).



Vouchers: *Cholnoky* 183, 348; *Kluge* 1022; *Rankin* 77; *Schelpe* 4406; *Van Rooy* 165.

The obtuse to rounded leaf apices, costa ending below apex and dorsal laminae ending above the insertion distinguish *F. asplenioides* in Southern Africa. The large plants and incrassate, mammillose leaf cells suggest a close relationship to *F. glaucescens;* see note under that species.

3. Subgenus **Pachyfissidens**

Pachyfissidens (*C. Müll.*) *Kindb.*, Eur. N. Amer. Bryin. 2: 165 (1897).

Section *Pachyfissidens* C. Müll., Syn. Musc. 1: 45 (1848).

Plants aquatic or semi-aquatic. *Stems* without central strand. *Leaves* costate, laminae bistratose.

27. **Fissidens fasciculatus** *Hornsch.* in Linnaea 15: 155 (1841); Broth. in Natürl. PflFam. 10: 153 (1924); Sim, Bryo. S. Afr. 202 (1926). Type: Cape, Du Toit's Kloof, Schönfeld, *Drège* s.n., 1828 (BM!).

Plants large, forming patches, dark green to blackish green; terricolous or saxicolous, aquatic to semi-aquatic. *Stems* 10–20 mm long, unbranched; in section elliptical, central strand present, inner cortical cells large, incrassate, in 3–4 rows, outer cortical cells smaller, strongly incrassate, marginal row stereids or substereids. *Leaves* crowded, larger above, appressed, curved dry, appressed to erect wet, linear-lanceolate, 3–5 mm long, bistratose above and in dorsal laminae; apex long-acuminate; margins elimbate, plane, entire; costa percurrent or ending just below apex. *Vaginant laminae* ½–¾ of leaf length, unistratose, termination of one blade laminal; dorsal lamina bistratose, tapering proximally, generally ending well above insertion. *Laminal cells* rounded, quadrate to rectangular or angular, 10–17 μm long, incrassate, smooth.

Dioicous. Perichaetia terminal; leaves undifferentiated. *Seta* 5–6 mm long, yellowish; capsule erect, urn short-cylindrical, to 1 mm long, red-yellow; exothecial cells quadrate to rectangular, thickened; peristome teeth deeply cleft, reddish; operculum rostrate; spores (immature) round, 12–15 μm, smooth. Fig. 16: 1–7.

Endemic to Southern Africa. *F. fasciculatus* is found in or around streams in the southern and south-western Cape. Map 19.

Vouchers: *Cholnoky* 360; *Crosby & Crosby* 9257; *Esterhuysen* 21229; *Magill* 6213.

The large, blackish green plants, narrow leaves and bistratose upper leaf and dorsal lamina characterize *F. fasciculatus*. The plants are somewhat similar to *F. plumosus* but the two species are easily separated, as the leaves of the latter are broader and unistratose throughout; see note under that species.

4. Subgenus **Octodiceras**

Octodiceras (Brid.) Broth. in Natürl. PflFam. 1: 361 (1901).

Genus *Octodiceras* Brid., Muscol. Recent. Suppl. 1: 162 (1806).

Plants aquatic, floating. *Stems* without central strand. *Leaves* costate; laminae unistratose.

28. **Fissidens fontanus** (*B. Pyl.*) *Steud.*, Nom. Bot. 2: 166 (1824); Scott & Stone, Moss. S. Aust. 86 (1976). Type: Europe.

Skitophyllum fontanum B. Pyl. in J. de Bot., sér 2, 4: 133 (1815). *Octodiceras fontanum* (B. Pyl.) Lindb. in Öfvers. K. VetenskAkad. Förh. 20: 405 (1863); Smith, Moss Fl. Brit. Irel. 204 (1978).

Fontinalis juliana (Savi) Savi ex Cand., Fl. Franc. ed. 3, 6: 236 (1815). *Octodiceras julianum* (Cand.) Brid., Bryol. Univ. 2: 678 (1827). *Conomitrium julianum* (Cand.) Mont. in Annls Sci. nat. Bot., ser. 2, 8: 246 (1837); Sim, Bryo. S. Afr. 205 (1926). *Fissidens julianus* (Cand.) Schimp. in Flora, Jena 21: 271 (1838); Broth. in Natürl. PflFam. 10: 153 (1924); Grout, Moss Fl. N. Amer. 1: 23 (1936). Type: Europe.

FIG. 16.—**Fissidens fasciculatus** (1–7): **1.** habit, ×1; **2.** habit, ×5; **3.** leaf, ×50; **4.** leaf base, ×170; **5.** upper laminal cells, ×640; **6.** cells at termination of vaginant lamina, ×170; **7.** leaf apex, ×170. **F. fontanus** (8–13): **8.** habit, ×1; **9.** habit, ×5; **10.** leaf, ×50; **11.** leaf base, ×170; **12.** upper laminal cells, ×435; **13.** leaf apex, ×170. (1–2, *Esterhuysen* 21229; 3–7, *Cholnoky* 359; 8–10, *Cholnoky* 604; 11–13, *Cholnoky* 641).

Conomitrium capensis C. Müll., Syn. Musc. 2: 524 (1851). *Octodiceras capensis* (C. Müll.) Jaeg. in Verh. St. Gall. naturw. Ges. 1874–75: 135 (1876). *Fissidens capensis* (C. Müll.) Broth. in Natürl. PflFam. 10: 154 (1924). Type: Cape, *Drège* sub 9379a & b (H-BR!).

Plants large to robust, flaccid, green, yellow-green or blackish; aquatic, saxicolous. *Stems* 50–100 mm long; in section subround, central strand absent, inner cortical cells large, irregularly thickened at corners, outer cortical cells small, round, incrassate. *Leaves* distant, spreading wet or dry; linear-lanceolate, (3–)4–7 mm long, somewhat flexuous above; apex acute to obtuse; margins elimbate, plane, entire to wavy; costa ending well below apex. *Vaginant laminae* $\frac{1}{4}$–$\frac{1}{3}$ of leaf length, equal or termination of one blade submarginal; dorsal lamina abruptly tapering proximally, not reaching stem. *Laminal cells* irregular, rectangular to hexagonal, 18–37 μm long, 12–15 μm wide, thin-walled, flat; juxtacostal cells somewhat larger, rectangular.

Autoicous, gametangia on short lateral branches. *Seta* very short, 0,4 mm long; capsule erect, urn elliptical, 0,5 mm long; peristome cleft and perforated; operculum rostrate; spores round, 18–20 μm. Fig. 16: 8–13.

Fissidens fontanus grows in water and is known from North, Central and southern South America, Europe and Africa. In Southern Africa the species is most common in Natal and Transkei, but specimens have been collected in the eastern Orange Free State, central and eastern Transvaal, Zululand, and the northern, southern and southwestern Cape. Map 8.

Vouchers: *Cholnoky* 593; *Esterhuysen* 17956; *Leighton* 3367.

The large, flaccid plants with long, distant, unistratose leaves characterize *F. fontanus*. Considering the size and habit of these plants and their aquatic nature, it is unlikely that this species could be confused with any other species of *Fissidens*. *Fontinalis antipyretica* bears some resemblance, but the two species are easily separated on generic characters.

Insufficiently Known Species

Fissidens longulus C. Müll. in Hedwigia 38: 56 (1899). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1883. The type has not been seen, however the description indicates a close resemblance to *F. pygmaeus* Hornsch.

Fissidens macleanus Shaw in Cape Monthly Mag. 17: 314 (1878). Type: Cape, Graaff-Reinet, *McLea* s.n. The Sim correspondence (PRE) indicates that the Shaw collection was destroyed sometime after his death. Attempts to locate the specimens in Southern Africa have been unsuccessful and duplicates were not found in the European herbaria likely to have Shaw specimens. Sim (1926) considered the species to be synonymous with *F. curvatus* Hornsch. (as *F. pycnophyllus*), although he did not see the type.

Fissidens pauperrimus C. Müll. in Hedwigia 38: 54 (1899), hom. illeg., non C. Müll. (1881). *Fissidens rutenbergii* Par., Ind. Bryol. Suppl. 164 (1900). Type: Southern Africa, *Rutenberg* s.n., 1877. The type specimen has not been seen. Some doubt exists on the occurrence of this species in the Flora area. The collector is known for his collections on Madagascar and other East African Islands, but he is not cited as a collector from Southern Africa.

NANOBRYACEAE

Plants small, scattered along a persistent protonema, yellow-green; terricolous or corticolous. *Stems* erect, central strand present. *Leaves* larger above, symmetrical; elliptical, abruptly subulate; base clasping stem; margins erect, entire or with large blunt tooth at shoulders. *Costa* present or absent, weak below, occasionally extending into subula. *Upper laminal cells* rhomboidal, thin-walled; basal cells scarcely differentiated.

Dioicous. Male plants smaller. Perichaetia terminal. *Seta* cygneous; capsule small, nodding or pendent, weakly asymmetric; peristome single, teeth 16, deeply cleft, red-yellow; operculum long-rostrate; calyptra cucullate, covering beak of operculum only; spores small, granulose.

Nanobryaceae is a monotypic family, known only from Africa.

NANOBRYUM

Nanobryum *Dix.* in J. Bot., Lond. 60: 101 (1922); Broth. in Natürl. PflFam. 11: 525 (1925); Sim, Bryo. S. Afr. 150 (1926); Schultze-Motel in Willdenowia 5: 386 (1969). Type species: *N. dummeri* Dix.

With characters of the family.

The genus *Nanobryum* consists of a single species reported from moist forests in several areas of Africa, south of the Sahara. In recent years the concept of the genus has apparently been altered from Dixon's (1922) description of plants intermediate between Fissidentaceae and Dicranaceae. It appears that several authors have placed small *Fissidens* species under *Nanobryum*. Examination of syntypes of *N. dummeri*, from Southern Africa, clearly supports Dixon's original description.

Nanobryum dummeri *Dix.* in J. Bot., Lond. 60: 101 (1922); Broth. in Natürl. PflFam. 11: 525 (1925); Sim, Bryo. S. Afr. 150 (1926). Syntypes: Uganda, Mulange, *Dummer* 4080a (BM); Kipayo, *Dummer* 1214; Transkei, Port St Johns, *Wager* 955 (BM!; PRE!).

Plants small, scattered, yellow-green; terricolous. *Protonema* persistent. *Stems* 0,1–0,2 mm tall, simple; in section round, central strand weak, inner cortical cells large, in single row, thin-walled, outer cortical cells smaller, in 2 rows, incrassate, yellow-brown. *Leaves* larger above, weakly flexuose dry, erect-spreading wet, elliptical, 0,4–1,0 mm long, upper and perichaetial leaves abruptly subulate, shoulders frequently with large, blunt tooth; base clasping stem; margins erect, entire. *Costa* weak below, stronger above, frequently extending into subula or completely absent in some leaves; in section round, guide cells 2–4, large, incrassate, ventral cells in single row, large, incrassate, dorsal cells in 2–3 rows, smaller, incrassate. *Upper laminal cells* fusiform to rhomboidal, thin-walled, smooth; basal cells rectangular, slightly larger.

Dioicous. Perichaetia terminal; leaves not differentiated. *Seta* cygneous, 2–3 mm long, yellowish; capsule nodding or pendent, asymmetrically ovoid, 0,5 mm long, yellowish, mouth reddish; exothecial cells quadrate, thickened at corners, smaller at mouth; peristome well developed, teeth 16, lanceolate, 0,3 mm long, cleft to near middle, finely papillose between trabeculae below, red-yellow, apical filaments spirally striate, hyaline; operculum rostrate, 0,4–0,6 mm long; calyptra cucullate, 0,4 mm long, covering operculum beak; spores round, 10–12 μm, granulate, yellowish. Fig. 17: 1–12.

The species is infrequently reported from moist forests of western, central, eastern and Southern Africa. In the Flora area the species has been collected only at Port St Johns in the Transkei. Map 22.

Voucher: Type only.

As suggested by Dixon, when he described the species, *N. dummeri* is intermediate between *Dicranella* and *Fissidens*. The sporophytes are practically

identical to the sporophytes of *Fissidens*, including peristome ornamentation. Gametophytically the plants are more similar to *Dicranella*. The plants examined showed a very symmetrical development of the lamina and no indication of a dorsal lamina as seen in *Fissidens*.

The plants from Oubangui, discussed and illustrated by R. Potier de la Varde (1927) under this name, undoubtedly belong to a species of *Fissidens* rather than to *Nanobryum*. Because of the apparent confusion of the identity of *N. dummeri* in the northern parts of its range, the combination *N. gladiolum* (Mitt.) Bizot, has not been adopted for the Southern African plants. It also appears from the illustration that Mitten's (1860) plant is properly placed in *Fissidens*; vide Bizot & Pócs (1979).

FIG. 17.—**Nanobryum dummeri: 1.** habit, ×1; **2.** habit, ×10; **3.** habit, ×20; **4.** stem in cross section, ×270; **5–7.** leaves, ×50; **8.** leaf in proximal section, ×435; **9.** leaf in distal section, ×435; **10.** cells at mid-leaf, ×170; **11.** upper leaf, ×170; **12.** peristome teeth, ×170. (1–12, *Wager* 53).

ARCHIDIACEAE

by J. VAN ROOY

Plants small, yellow to yellow-green; terricolous. *Stems* erect or prostrate, often stoloniferous, frequently branching by subperichaetial innovations; in section round, central strand present, inner cortical cells large, outer cortical cells usually smaller. *Leaves* frequently reduced to bracts below, primary stem and innovation leaves usually similar, but innovation leaves smaller.

Autoicous. Perigonia gemmate, terminal on short lateral branches or axillary on stem. Perichaetia gemmate, terminal or lateral; leaves erect to erect-spreading, frequently concave, elliptic or oblong to ovate or lanceolate, apex apiculate, acute, acuminate or subulate; margins plane to recurved, entire, serrulate, irregularly crenulate or papillose-denticulate. *Costa* in section circular, semi-circular or crescent-shaped, cells undifferentiated or dorsal cells smaller, incrassate or stereids. *Laminal cells* uniform or irregular in shape; basal cells rectangular, thin-walled, larger, hyaline. *Capsules* subsessile or sessile, cleistocarpic; globose, wall single-layered, undifferentiated, semi-transparent, yellowish, with brownish spots when mature, stomata absent; calyptra undeveloped, inconspicuous; spores large, >50 μm, rounded to polyhedral, thick-walled, smooth to densely papillose, pale yellow to brown, 4–180 per capsule.

During compilation of Archidiaceae, a revision of the genus *Archidium* (Snider, 1975), was consulted freely and was invaluable in completing this study.

ARCHIDIUM

Archidium *Brid.*, Bryol. Univ. 1: 747 (1827); Broth. in Natürl. PflFam. 10: 155 (1924); Sim, Bryo. S. Afr. 140 (1926); Snider in J. Hattori bot. Lab. 39: 122 (1975). Type species: *A. phascoides* Brid.

With characters of the family.

Small plants forming cushions, turfs, or tufts on sandy or gravelly soils. The small size and yellowish colour make *Archidium* difficult to see in the field. Many of the Southern African species are only represented by a few specimens or even single collections. Sterile plants of *Archidium* can easily be mistaken for small species of *Bryum* and therefore fruiting plants are generally needed for identification.

Archidium is cleistocarpic and the sessile or subsessile, globose capsule is surrounded by large perichaetial leaves. All Southern African species of *Archidium* are autoicous and the capsules are terminal, except in *A. ohioense* where the capsules are terminal or lateral. Only a few spores are produced in each capsule but they are extremely large.

The greatest number of described species is found in Africa, where 14 of the c. 26 species of *Archidium* occur. Eleven species occur in Southern Africa, seven are endemic to the Flora region. Of the endemic taxa five are very restricted in distribution, and are presently known only from the southwestern Cape.

1 Spores <100 μm in diameter, smooth, 75–178 spores per capsule (Subgenus *Archidiella*)..... 1. *A. dinteri*

1 Spores >100 μm in diameter, smooth to densely papillose; 4–70 spores per capsule (Subgenus *Archidium*):

2 Spores densely papillose.....6. *A. muelleranum*

2 Spores smooth to granulose:

3 Most leaf margins irregularly denticulate; branch leaves appressed.....9. *A. julicaule*

3 Leaf margins entire to crenulate; branch leaves generally erect-spreading:

4 Perichaetial leaf cells 40–100 μm long; costa in section circular:

5 Costa percurrent to short-excurrent:

6 Perichaetial leaf cells irregularly rectangular.....5. *A. subulatum*

6 Perichaetial leaf cells fusiform to rhomboidal:

7 Upper stem leaf margins plane; leaves narrow; laminal cells regular in shape.... 2. *A. ohioense*

7 Upper stem leaf margins narrowly recurved; leaves broad; laminal cells irregular in shape .....11. *A. andersonianum*

5 Costa excurrent, frequently forming distinct awn:

8 Laminal cells of upper stem leaves short-rhombic to rhomboidal; apex short-acuminate; costa long excurrent ..... 4. *A. acanthophyllum*

8 Laminal cells of upper stem leaves elongate, rhomboidal to fusiform; apex acuminate to long-acuminate:

9 Costa long-excurrent; upper perichaetial leaf cells narrow, cell walls 3–7 μm wide ..... 3. *A. microthecium*

9 Costa excurrent; upper perichaetial leaf cells wide, cell walls < 4 μm thick ..... 2. *A. ohioense*

4 Perichaetial leaf cells 15 to 45 μm long, occasionally some cells longer; costa in section crescent-shaped or semi-circular:

10 Costa excurrent as a distinct awn ..... 8. *A. capense*

10 Costa percurrent:

11 Perichaetial leaves bistratose juxtacostally ..... 7. *A. rehmannii*

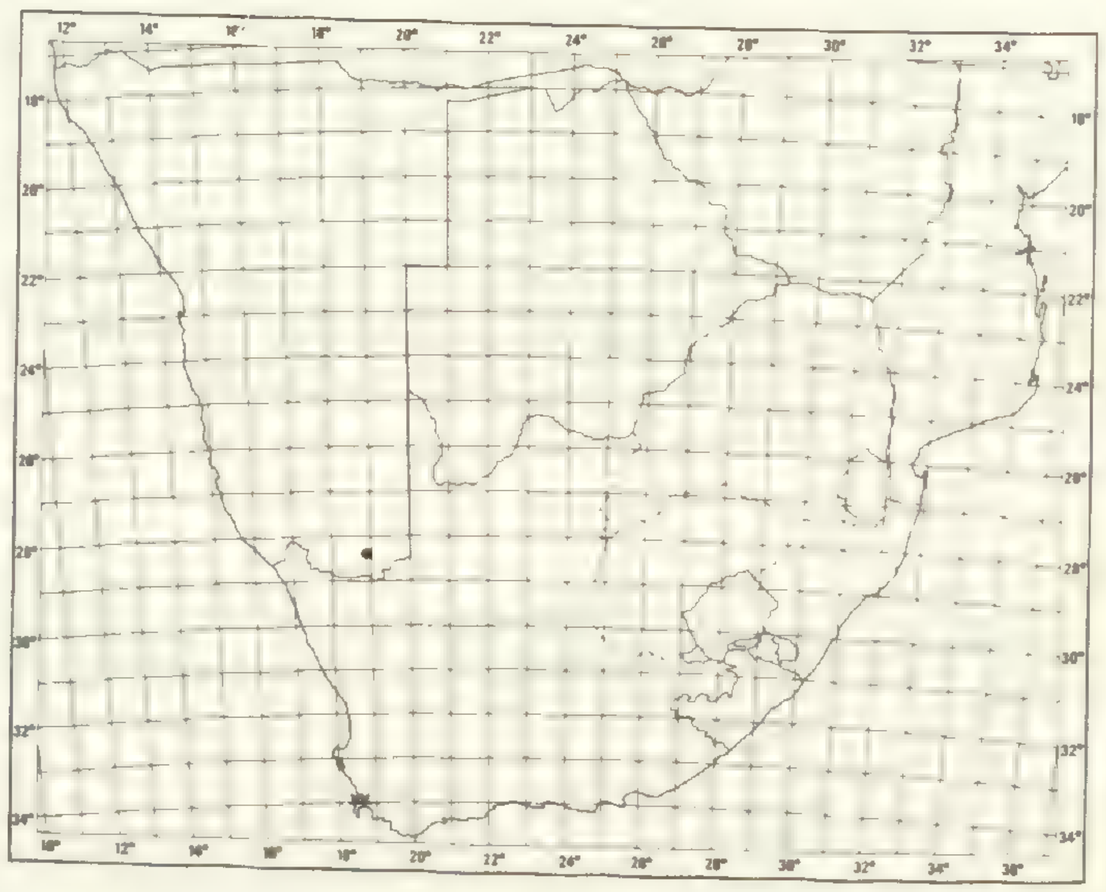
11 Perichaetial leaves unistratose juxtacostally ..... 10. *A. amplexicaule*

1. **Archidium dinteri** (*Irmsch.*) *Snider* in J. Hattori bot. Lab. 39: 126 (1975). Type: South West Africa/Namibia, near Warmbad, *Dinter* s.n., 1924 (HBG, holo.).

Archidiella dinteri Irmsch. in Mitt. Inst. allg. Bot., Hamb. 6: 338 (1926).

Plants forming loose mats, yellow-green; terricolous. *Stems* to 10 mm long, prostrate or suberect, stoloniferous, branching; in section central strand present, cortical cells large, thin-walled, outer 1–2 rows smaller. *Leaves* bract-like, appressed; short-acuminate to apiculate, 0,2–0,4 mm long; margins plane, entire to denticulate. *Costa* subpercurrent to percurrent, weak. *Laminal cells* rhomboidal or rectangular, thin-walled.

Perichaetia terminal on erect branches. *Leaves* erect, concave, ovate to obovate, apex short-acuminate or apiculate, 0,5–1,0 mm long; margins plane, entire or denticulate above. *Costa* percurrent, weak; in section semi-circular, cells undifferentiated, in 2 rows. *Laminal cells* irregularly rhomboidal or rectangular, 30–50 μm long, thin-walled; apical cells longer; basal marginal cells hyaline. *Spores* 75–178 per capsule, irregularly rounded to polyhedral, 48–82 μm, smooth, yellow. Fig. 18: 1–10.



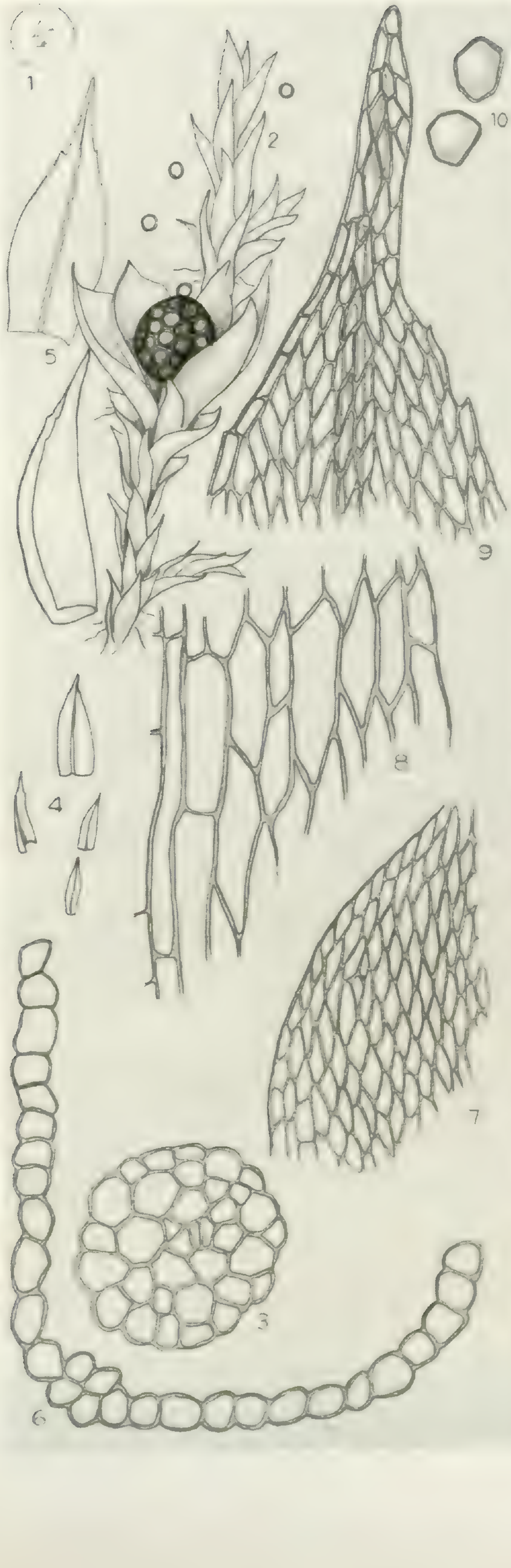
MAP 23.— ● **Archidium dinteri**
× **Archidium muelleranum**

Archidium dinteri is known from only two specimens, collected at Warmbad and Dassiskuppe in South West Africa/Namibia, on quartz sand. Map 23.

Voucher: *Volk* 6903.

The subgenus *Archidiella* (Irmsch.) Snider is based on *A. dinteri* and can be separated from the subgenus *Archidium* by the differences in spore size and number.

FIG. 18.—**Archidium dinteri** (1–10): **1.** habit, ×1; **2.** habit showing capsule and spores, ×40; **3.** stem in cross section, ×435; **4.** leaves, ×40; **5.** perichaetial leaves, ×40; **6.** perichaetial leaf in cross section, ×435; **7.** perichaetial leaf cells (upper left margin), ×170; **8.** upper laminal cells of perichaetial leaf, ×640; **9.** perichaetial leaf apex, ×170; **10.** spores, ×170. **A. ohioense** (11–16): **11.** habit, ×1; **12.** habit, ×40; **13.** leaves, ×10; **14.** perichaetial leaf, ×40; **15.** upper perichaetial leaf cells, ×435; **16.** cells in upper perichaetial leaf, ×170. **A. microthecium** (17–22): **17.** habit, ×1; **18.** habit, ×40; **19.** leaves, ×40; **20.** perichaetial leaf, ×40; **21.** upper perichaetial leaf cells, ×435; **22.** cells in upper perichaetial leaf, ×170. (1–6 & 8–10, *Volk* 6903; 7, *Dinter* 1924; 11–12, *Sim* 10004; 13–16 *Magill* 3563; 17–22, *Magill* 4951).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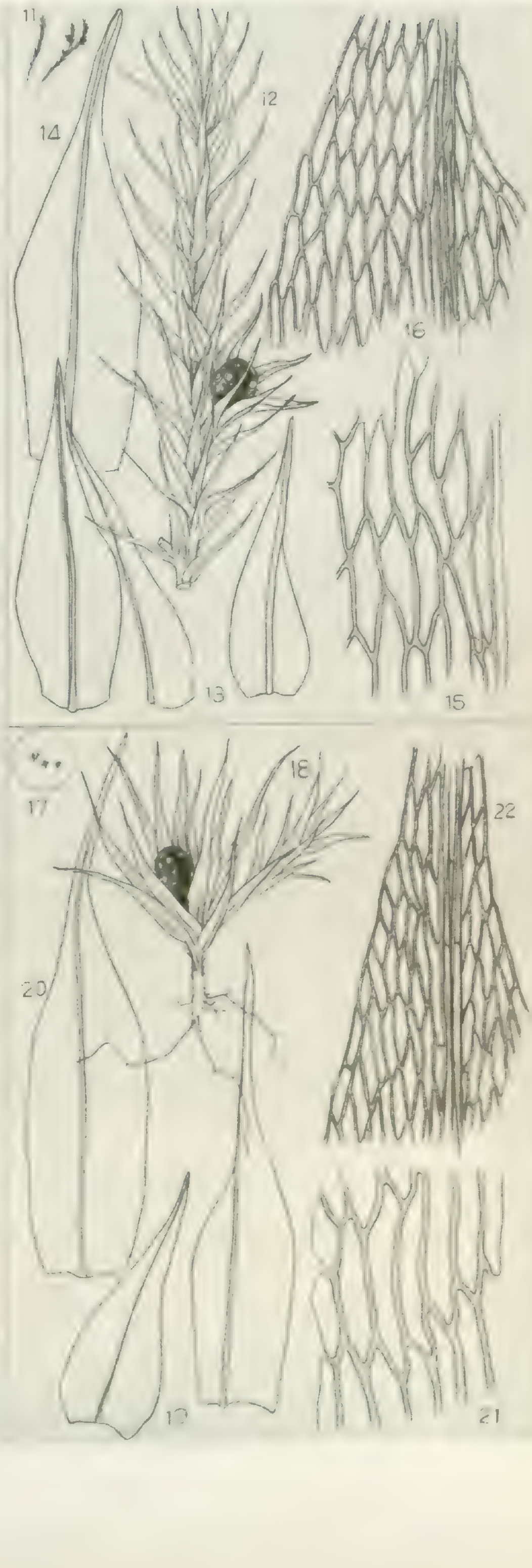
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2. **Archidium ohioense** *Schimp. ex C. Müll.*, Syn. Musc. 2: 517 (1851); Snider in J. Hattori bot. Lab. 39: 135 (1975). Type: United States of America, *Sullivant*, Musci Allegh. 213 (FH, lecto.), vide Snider (1975).

Archidium africanum Mitt. in J. Linn. Soc., Bot. 22: 299 (1885); Sim, Bryo. S. Afr. 140 (1926). Type: Tanzania, Usagara Mtns, *Hannington* s.n. (NY, holo.).

Archidium pellucidum Dix. ex Sim, Bryo. S. Afr. 142 (1926). Type: South West Africa/Namibia, Erongo Mtns, *Pearson* 9849 (BM, holo.; PRE!).

Archidium leptophyllum P. Varde in Revue bryol. lichen. 59: 86 (1932). Type: Central African Republic, *Tisserant* 566d (PC, holo.).

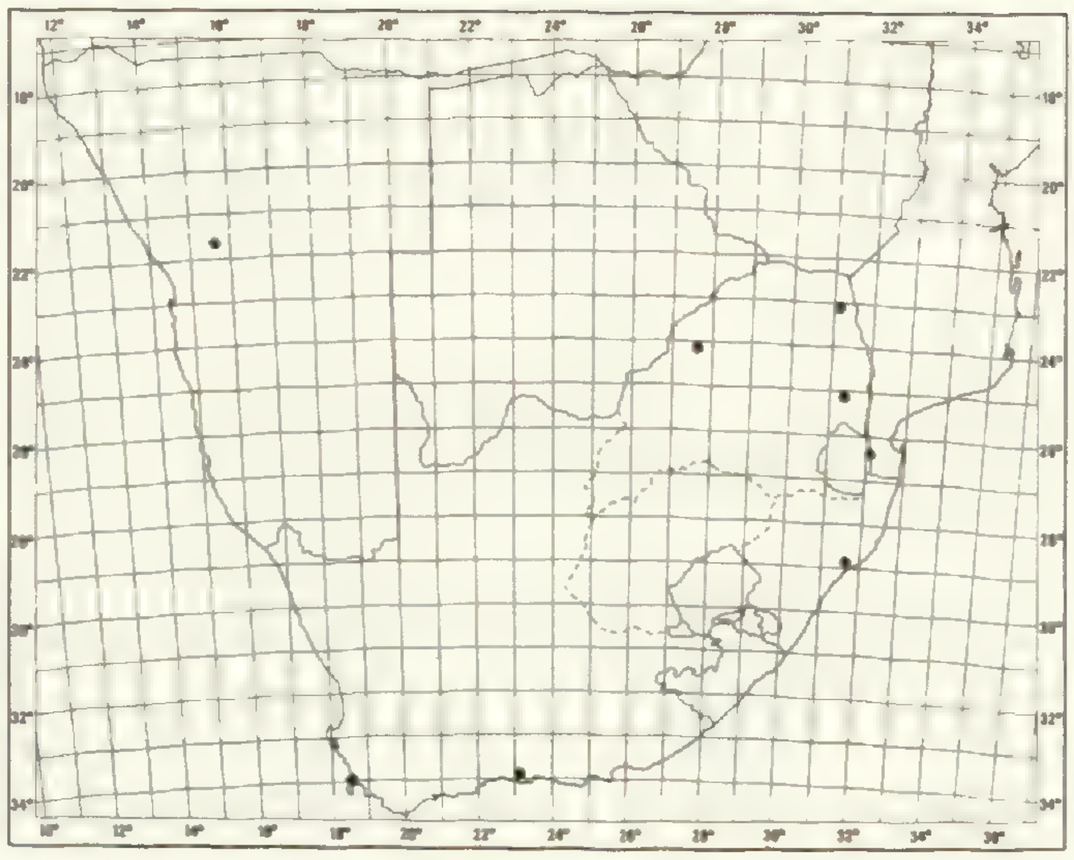
Plants forming loose turfs, yellow-green; terricolous. *Stems* erect or subflexuose, 2–15 mm high, simple or branching; in section with central strand, cortical cells large, thin-walled, outer 1–2 rows smaller. *Leaves* bract-like below, erect-spreading or wide-spreading above, ovate-lanceolate to ovate or occasionally narrowly lanceolate, short-acuminate to subulate, 0,9–1,5 mm long; base often clasping; margins plane, entire or serrulate above. *Costa* percurrent to excurrent as hair-point; in section cells undifferentiated. *Laminal cells* rhomboidal to fusiform, basal cells rectangular to quadrate.

Perichaetia terminal or lateral. *Leaves* erect, ovate, oblong-ovate, ovate-lanceolate or lanceolate, acuminate, 0,7–1,8 mm long; margins plane to recurved; entire to serrulate above. *Costa* percurrent to excurrent as hair-point; in section round, cells undifferentiated, incrassate. *Laminal cells* rhomboidal to fusiform, frequently lax, 37–95 μm long, walls (1,7–) 2,8 (—4,4) μm wide, lumen (7—) 12 (—15) μm wide; basal cells rhomboidal to rectangular, lax, hyaline below. *Spores* 8–60 per capsule, rounded triangular to polyhedral, 97–176 μm, smooth to granulose, yellow. Fig. 18: 11–16.

This species is widely distributed and has been collected in North America, West Indies, India, Sri Lanka, Japan and Africa. In Southern Africa it is known from the southwestern and southern Cape, Zululand, Swaziland and the eastern and central Transvaal and South West Africa/Namibia. The plants grow on sandy soil in moist or dry habitats. Map 24.

Vouchers: *Magill* 3563; *Sim* 10004; *Wager* 63.

Two growth forms of *A. ohioense* can be recognized in Southern Africa. In the short 'form', branching is mostly by subperichaetial innovations; the stem leaves are rapidly reduced to ovate-lanceolate bracts below, and the perichaetial leaves are large, broadly ovate-lanceolate and have percurrent to excurrent costae. The tall, little branched, subflexuose 'form' has lateral perichaetia. The narrowly long-triangular stem leaves are distant, widespreading and reduced only near the stem base. The perichaetial leaves in this 'form' are smaller with a more or less percurrent costa. Although there is a complete gradient from the short 'form' to the tall 'form' in North America (Snider, 1975), this is not evident in Southern Africa. The tall, subflexuose 'form' occurs in moist, shady habitats and is known in Southern Africa from a single specimen collected in the Ngoya Forest of Zululand. The short 'form' is more common and occurs in drier, open habitats.



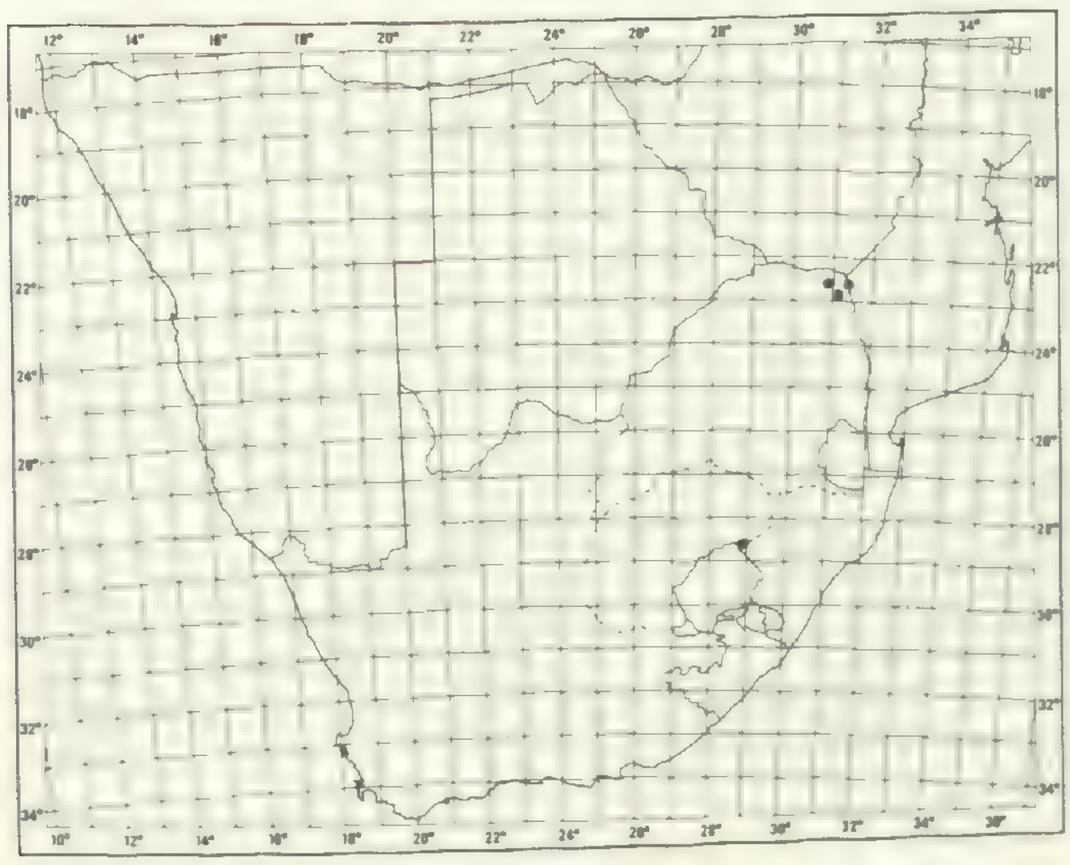
MAP 24.— ● **Archidium ohioense**

3. **Archidium microthecium** *Dix. & P. Varde* in Ann. Cryptog. Exot. 1: 37 (1928); Snider in J. Hattori bot. Lab. 39: 141 (1975). Type: India, Kodiakanal, *Foreau* 211 (BM, holo.).

Plants caespitose, yellow or yellow-green; terricolous. *Stems* 1–5 mm high, branching by subperichaetial innovations; in section with central strand of collapsed cells, inner cortical cells thin-walled, large, in single row, outer cortical cells smaller, in 1–2 rows. *Leaves* bract-like below, larger above, erect to erect-spreading, ovate-lanceolate to lanceolate, acuminate, 0,9–1,1 mm long; margins plane, entire. *Costa* excurrent or forming hair-point; in section round, cells undifferentiated, incrassate or stereids. *Laminal cells* rhomboidal to fusiform, incrassate; basal cells short-rectangular to quadrate; lower marginal cells rectangular to quadrate.

Perichaetia terminal. *Leaves* erect to erect-spreading, occasionally secund; ovate-lanceolate to oblong-lanceolate, acuminate, 0,8–1,4 mm long; margins entire, plane to faintly recurved above. *Costa* excurrent as hair-point; in section round, surface cells incrassate or substereids, central cells substereids to stereids. *Laminal cells* fusiform, shorter above and along margins, 48–88 μm long, walls 3–7 μm wide, lumen 5–9 μm wide; basal cells rectangular, thin-walled, basal marginal cells hyaline. *Spores* 10–17 per capsule, irregularly rounded, 88–202 μm, smooth to granulose, yellow. Fig. 18: 17–22.

This species has been collected on sandy soils in South West Africa/Namibia, Natal and the Kruger National Park in the northeastern Transvaal. The plant also occurs in east Africa and southern and eastern India. Map 25.



MAP 25.— ● **Archidium microthecium**
× **Archidium subulatum**

Vouchers: *Magill* 4948, 4997; *Volk* 01160.

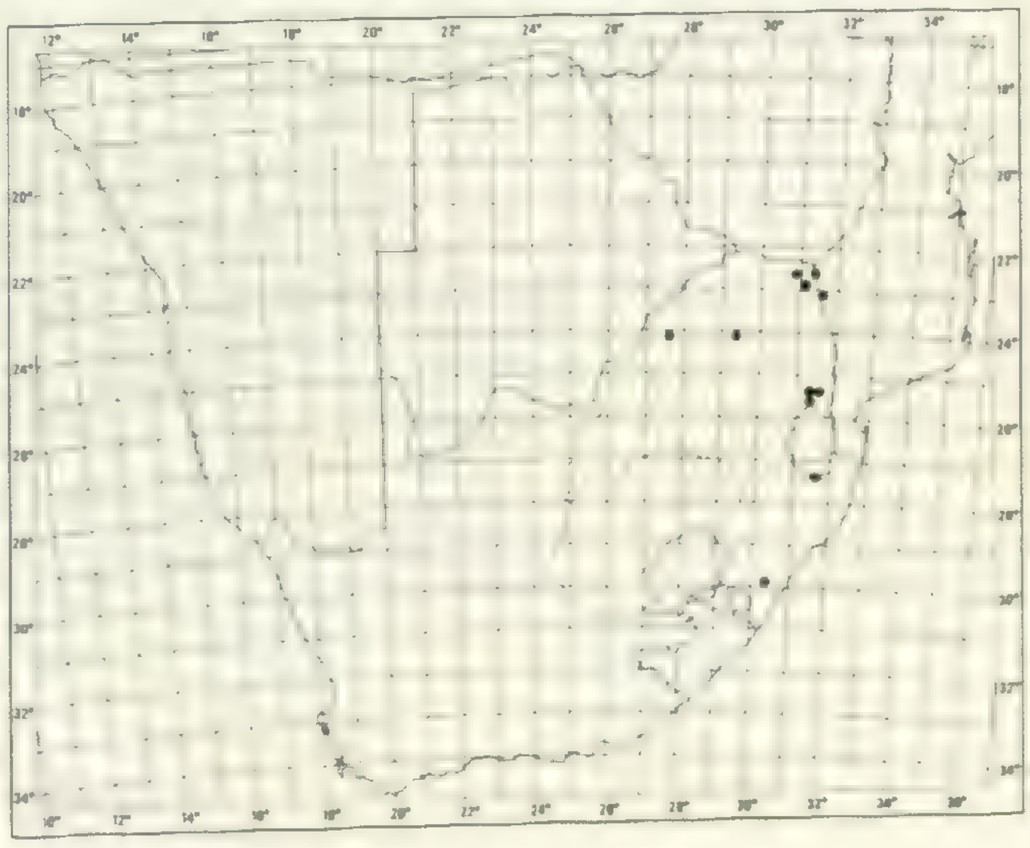
Archidium microthecium is separated from the closely related *A. ohioense* on the basis of its narrower and more incrassate lamina cells, long-excurrent costa, and oblong-lanceolate perichaetial leaves.

4. **Archidium acanthophyllum** *Snider* in Bryologist 78: 152 (1975). Type: Transvaal, Kruger National Park, Pretoriuskop, *Godfrey* GH.1649b (DUKE, holo.).

Plants forming turfs, yellow to yellow-green; terricolous. *Stems* erect or prostrate, 3–8 mm tall, branching; in section with central strand of collapsed cells, cortical cells large, thin-walled in 2–3 rows. *Leaves* bract-like below, erect to spreading above; ovate to ovate-lanceolate, acuminate, 0,9–1,8 mm long; margins plane, entire. *Costa* excurrent as hair-point; in section round, cells undifferentiated, substereids to stereids. *Laminal cells* short-rhombic to rhomboidal; marginal cells shorter or rectangular to quadrate; basal cells short-rectangular to quadrate.

Perichaetia terminal. *Leaves* erect, ovate-lanceolate, acuminate, 1–2 mm long; margins entire, plane to recurved. *Costa* excurrent as hair-point; in section round, cells undifferentiated, incrassate or stereids. *Laminal cells* rhombic to rhomboidal, 70–90 (100) μm long; apical and marginal cells shorter; basal cells rectangular to quadrate, frequently hyaline. *Spores* 12–20 per capsule, rounded-triangular to tetrahedral, 120–185 μm, smooth or granulose, yellowish. Fig. 19: 1–9.

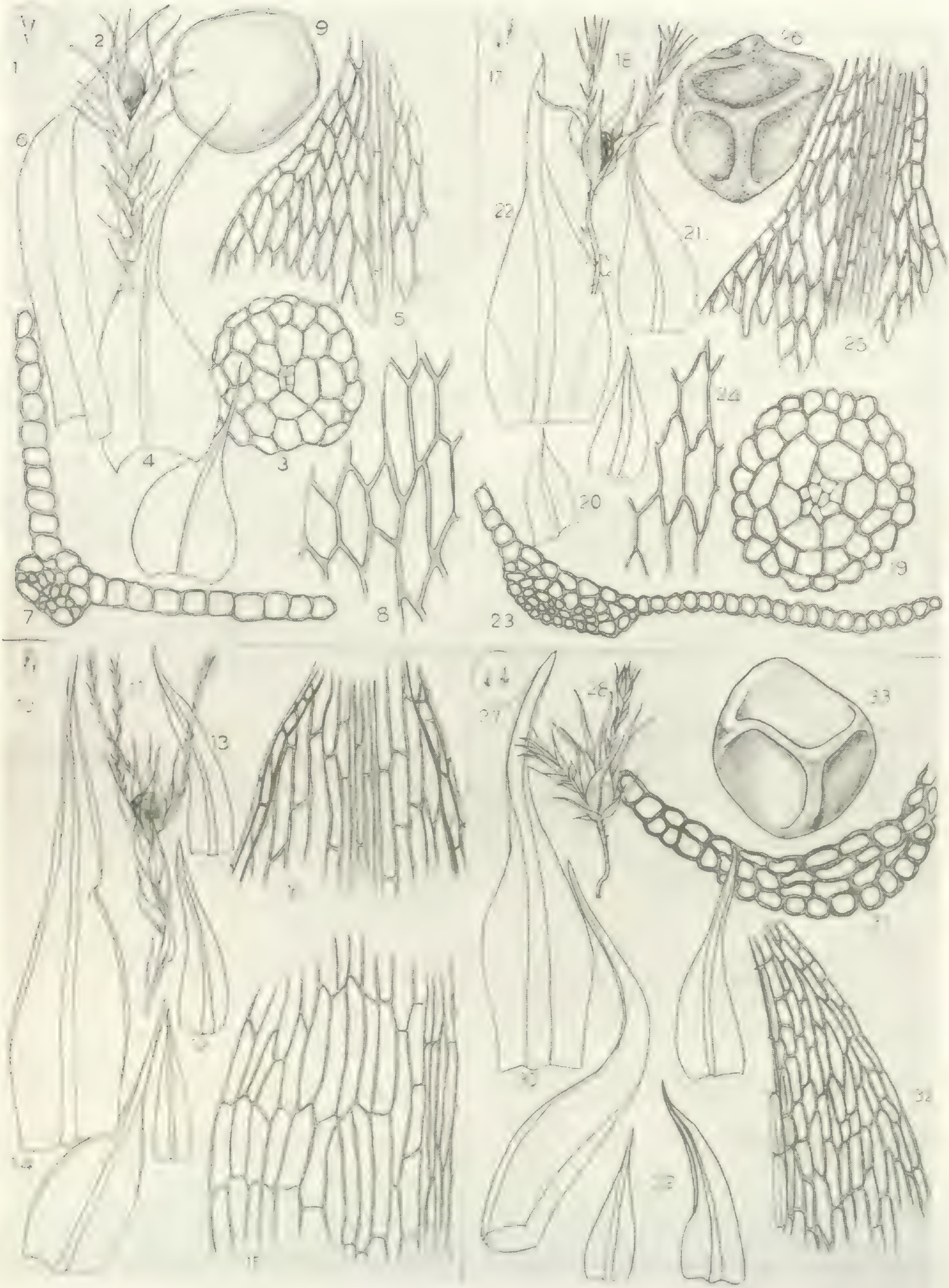
This plant has been collected in woodlands of central, northern and eastern Transvaal, Zululand and Natal and is also known from Zaire. Map 26.



MAP 26.— ● **Archidium acanthophyllum**
× **Archidium julicaule**

Vouchers: *Magill* 5004; *Van Vuuren* 1772; *Wager* PRE-CH19.

Archidium acanthophyllum may be separated from the very similar *A. ohioense* and *A. microthecium* on the basis of the short-rhombic to rhomboidal laminal cells, long-excurrent costa, ovate to ovate-lanceolate leaves and short-acuminate apices. This species is the most frequently collected species of *Archidium* in Southern Africa.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5. **Archidium subulatum** *C. Müll.* in Flora, Jena 71: 7 (1888). Snider in J. Hattori bot. Lab. 39: 144 (1975). Type: Cape, Cape Town, *Rehmann* s.n., 1876 (S-PA, lecto.!), vide Snider (1975).

Plants in dense tufts, yellow to yellow-brown; terricolous. *Stems* erect or prostrate, old stems stoloniferous, 4–15 mm long, simple or branching by subperichaetial innovations, central strand small, cells thin-walled, inner cortical cells large, thin-walled, in 2 rows, outer cortical cells small, in 1–2 rows. *Leaves* erect-spreading; ovate-lanceolate to lanceolate, acuminate, 0,9–1,3 mm long; margins plane to recurved above, entire to serrulate above. *Costa* percurrent to short-excurrent; in section round, central cells substereids, surface cells incrassate. *Laminal cells* laxly rectangular to rhomboidal above; basal cells rectangular to quadrate below, lax, lower marginal cells short-rectangular to quadrate.

Perichaetia terminal. *Leaves* erect; oblong-acuminate, 1,3–2,4 mm long; base ovate; margins recurved above, entire. *Costa* percurrent to short-excurrent; in section round, central cells incrassate or substereids, surface cells incrassate. *Laminal cells* laxly rectangular to rhomboidal, 80–110 μm long, basal cells larger, laxly rectangular. *Spores* 8–60 per capsule, rounded to irregularly angular or polyhedral, 150–170 μm, smooth to granulose, yellow. Fig. 19: 10–16.

Endemic to Southern Africa, this species grows on sandy soils in the fynbos biome of the south-western Cape. Map 25.

Voucher: *Bews* 8421.

Archidium subulatum can be distinguished by its laxly rectangular median leaf cells and the percurrent costa.

6. **Archidium muelleranum** *Snider* in Bryologist 78: 154 (1975), as *A. muellerianum*. Type: Cape, *Rehmann* 388 (S-PA, holo.).

Plants loosely caespitose, yellow to yellow-green; terricolous. *Stems* 3–5 mm high, branching by subperichaetial innovations; in section central strand present, inner cortical cells large, incrassate, in 1–3 rows, outer cortical cells smaller, incrassate, in 1–3 rows. *Leaves* bract-like below, larger above, erect-spreading to spreading, concave; ovate-lanceolate, acuminate, 0,9–1,2 mm long; margins plane to slightly recurved, entire. *Costa* percurrent to short-excurrent; in section semi-circular, ventral surface flat, cells incrassate or stereids dorsally, ventral cells larger. *Laminal cells* irregularly short-rectangular to quadrate or trapezoidal; basal cells not differentiated or slightly larger.

Perichaetia terminal. *Leaves* erect to erect-spreading, frequently secund, concave; broadly ovate-lanceolate to oblong-ovate, acuminate to subulate, 1,4–2,0 mm long; base broadly ovate to oblong or concave; margins narrowly recurved above, entire. *Costa* percurrent to slightly excurrent, in section semi-circular, ventral surface flat, dorsal cells incrassate or stereids, ventral cells larger. *Laminal cells* irregularly rectangular to rhomboidal or trapezoidal, 40–80 μm long, larger below, basal cells irregularly rectangular, thin-walled, hyaline. *Spores* 20–40 per capsule, irregularly rounded triangular to tetrahedral, 149–185 μm, densely papillose, yellow to yellow-brown. Fig. 19: 17–26.

This plant is endemic to the southwestern Cape and grows on sandy soil. Map 23.

Vouchers: *Magill* 4101; *Parker* 24849 (BOL!); *Rehmann* 427.

Archidium muelleranum can be distinguished by its densely papillose spores and strongly recurved upper margins of the perichaetial leaves.

7. **Archidium rehmannii** *Mitt.* in J. Linn. Soc., Bot. 22: 300 (1885); Snider in J. Hattori bot. Lab. 39: 148 (1975). Type: Cape, Cape Town, *Rehmann* s.n. (NY, holo.).

FIG. 19.—**Archidium acanthophyllum** (1–9): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×170; **4.** leaves, ×40; **5.** leaf apex, ×170; **6.** perichaetial leaf, ×40; **7.** perichaetial leaf in cross section, ×170; **8.** perichaetial leaf cells, ×435; **9.** spore, ×170. **A. subulatum** (10–16): **10.** habit, ×1; **11.** habit, ×10; **12–13.** leaves, ×40; **14.** perichaetial leaves, ×40; **15.** perichaetial leaf cells (left side), ×170; **16.** cells in upper perichaetial leaf, ×170. **A. muelleranum** (17–26): **17.** habit, ×1; **18.** habit, ×10; **19.** stem in cross section, ×170; **20–21.** leaves, ×40; **22.** perichaetial leaf, ×40; **23.** perichaetial leaf in cross section, ×170; **24.** perichaetial leaf cells, ×435; **25.** cells in upper perichaetial leaf, ×170; **26.** spore, ×170. **A. rehmannii** (27–33): **27.** habit, ×1; **28.** habit, ×10; **29.** leaves, ×40; **30.** perichaetial leaf, ×40; **31.** perichaetial leaf in cross section, ×435; **32.** cells in upper perichaetial leaf (right side), ×170; **33.** spore, ×170. (1–9, *Van Vuuren* 1735; 10–16, *Bews* 8421; 17–26, *Rehmann* 429*d*; 27–33, *Rehmann* 427).

Plants caespitose, yellow-green; terricolous. *Stems* 2–10 mm high, branching by subperichaetial innovations; in section with central strand of collapsed cells, inner cortical cells large, in 2 rows, outer cortical cells smaller, in 1–2 rows. *Leaves* bract-like below, larger above, erect to spreading; ovate-lanceolate to lanceolate, acuminate, 0,9–1,2 mm long, ventral surface flat to channelled; base often clasping; margins plane to recurved above, entire; lamina bistratose juxtacostally. *Costa* percurrent; in section crescent-shaped, ventral surface flat, cells undifferentiated, incrassate. *Laminal cells* irregular, trapezoidal, short-rectangular, quadrate and short-rhomboidal; basal cells irregularly short-rectangular to quadrate.

Perichaetia terminal. *Leaves* erect, loosely secund, concave, narrowly acuminate to subulate above an ovate to oblong base, 1,2–1,8 mm long; margins plane to recurved above, entire to crenulate; lamina bistratose juxtacostally. *Costa* percurrent to excurrent; in section crescent-shaped, ventral surface flat, cells undifferentiated, incrassate. *Laminal cells* irregular, rectangular to trapezoidal or rhomboidal, 30–60 μm long, larger below; basal cells irregularly rectangular to rhomboidal, thin-walled, hyaline. *Spores* 12–28 per capsule, 132–167 μm, smooth to granulose, yellow. Fig. 19: 27–33.

This species is endemic to the fynbos biome of the southwestern Cape. Map 27.

Voucher: *Rehmann* 429.

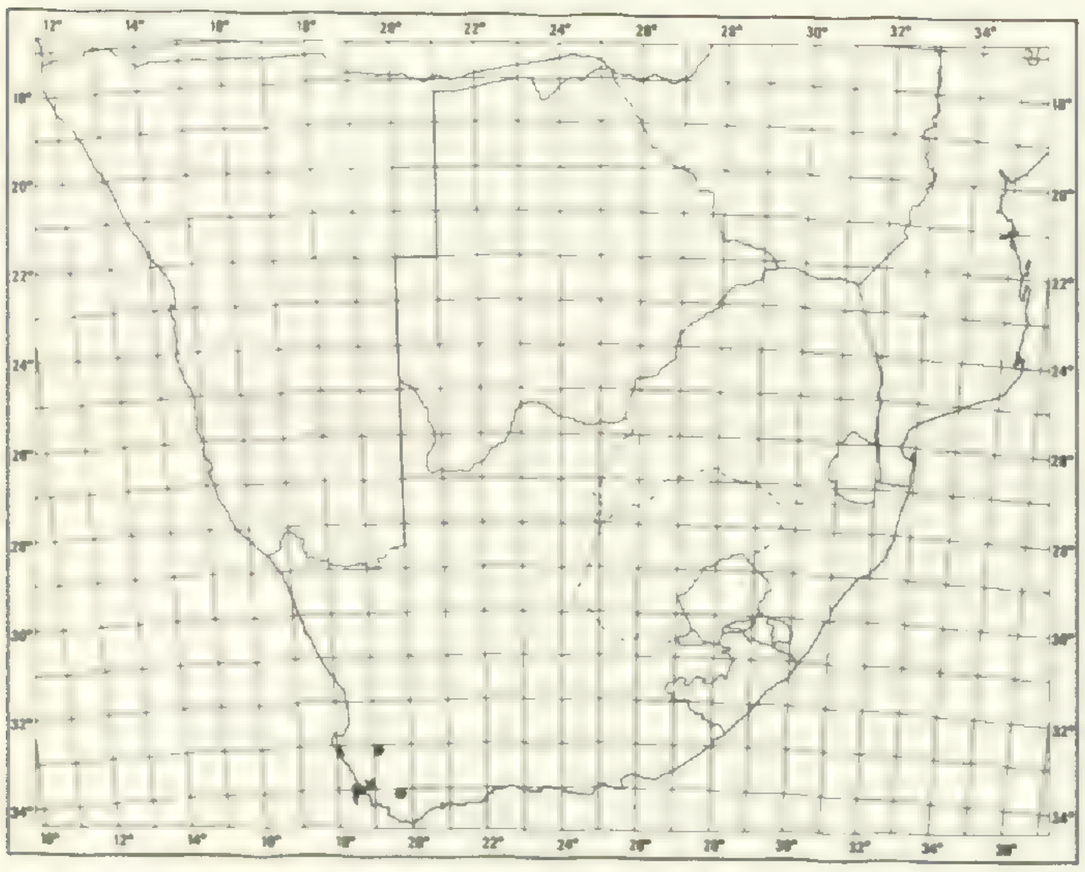
The perichaetial leaves of *A. rehmannii* are narrowly acuminate to long-subulate from an ovate to oblong or occasionally elliptic base, the leaf margins are plane or rarely recurved and the leaves appear loosely secund. These characters define the species.

8. **Archidium capense** *Hornsch.* in Linnaea 15: 135 (1841); Sim, Bryo. S. Afr. 141 (1926); Snider in Bryologist 78: 148 (1975). Type: Cape, *Ecklon,* 1827 (H, lecto.), vide Snider (1975).

Archidium campylopodium C. Müll. in Hedwigia 38: 52 (1899). Type: Cape Town, *Rehmann* s.n., 1875 (S-PA, lecto.).

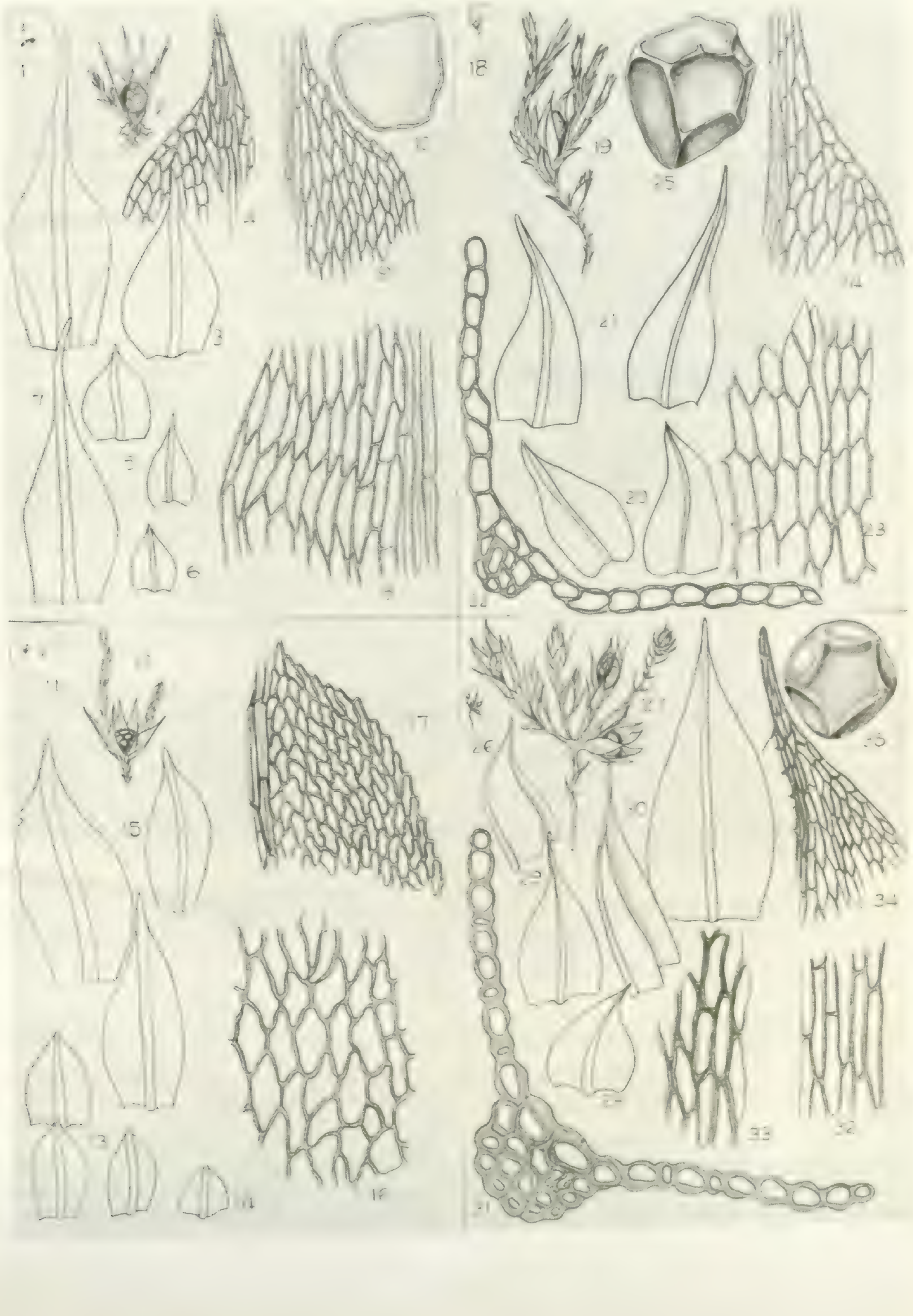
Archidium compactum fo. *tenerior* C. Müll. in Hedwigia 38: 52 (1899), nom. nud. Type: Orange Free State, Bloemfontein, *Rehmann* s.n.

Plants loosely caespitose, yellow to yellow-green; terricolous. *Stems* 1–4 mm high, simple or branching by subperichaetial innovations; in section round, central strand of collapsed cells, cortical cells large, incrassate, outer 1–2 rows smaller. *Leaves* bract-like below, larger above, erect; ovate to ovate-lanceolate, 0,6–1,0 mm long; apex acute or apiculate; margins plane, entire to crenulate. *Costa* percurrent to apiculate; in section semi-circular or crescent-shaped, ventral surface flat, cells undifferentiated, substereids or stereids. *Laminal cells* irregular, short-rectangular to quadrate or trapezoidal; basal cells not differentiated.



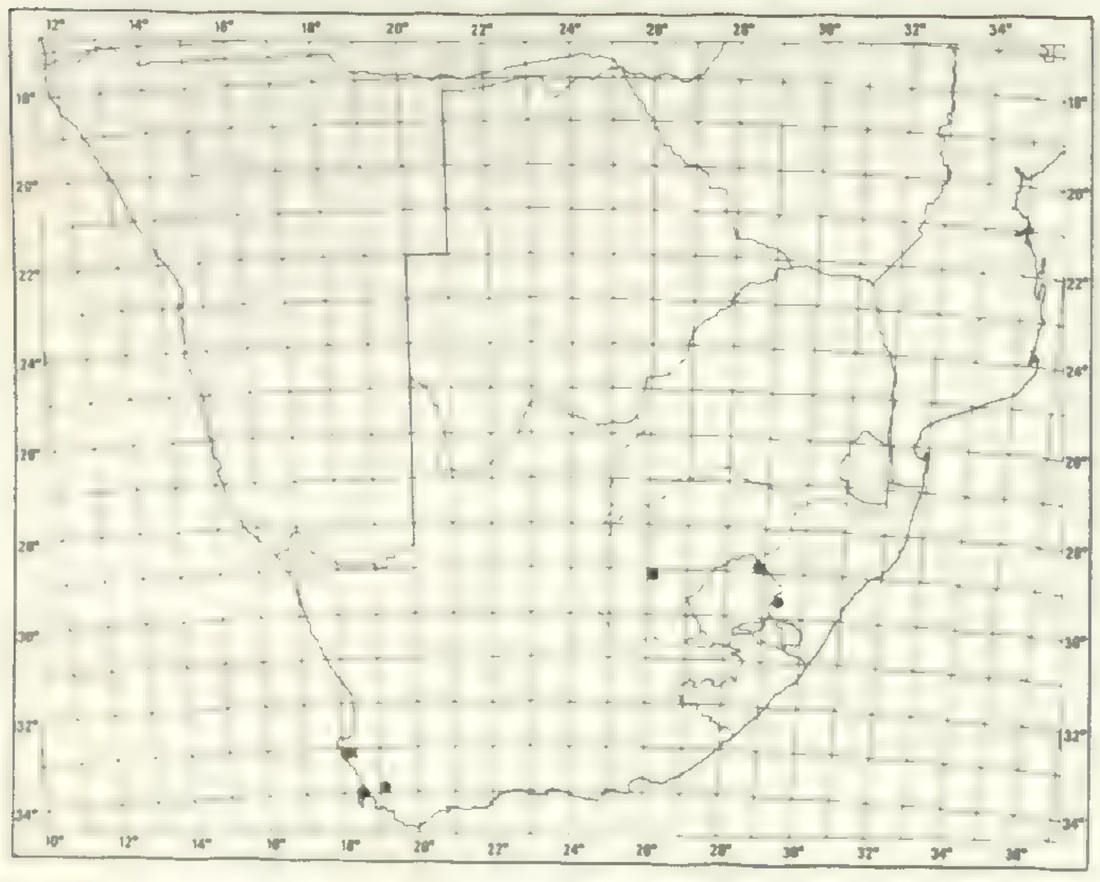
MAP 27.— ● **Archidium rehmannii**
× **Archidium andersonianum**

FIG. 20.—**Archidium capense** (1–10): **1.** habit, ×1; **2.** habit, ×10; **3.** leaf, ×40; **4.** leaf apex (left side), ×170; **5–6.** innovation leaves, ×40; **7.** perichaetial leaves, ×40; **8.** perichaetial leaf cells (left side), ×170; **9.** cells in upper perichaetial leaf, ×170; **10.** spore, ×170. **A. julicaule** (11–17): **11.** habit, ×1; **12.** habit, ×10; **13.** leaves, ×40; **14.** innovation leaf, ×40; **15.** perichaetial leaves, ×40; **16.** perichaetial leaf cells, ×435; **17.** cells in upper perichaetial leaf (right side), ×170. **A. amplexicaule** (18–25): **18.** habit, ×1; **19.** habit, ×10; **20.** leaves, ×30; **21.** perichaetial leaves, ×30; **22.** perichaetial leaf in cross section, ×435; **23.** perichaetial leaf cells, ×170; **24.** perichaetial leaf apex (right side), ×170; **25.** spore, ×170. **A. andersonianum** (26–35): **26.** habit, ×1; **27.** habit, ×10; **28.** innovation leaf, ×30; **29.** leaves, ×30; **30.** perichaetial leaves, ×30; **31.** perichaetial leaf in cross section, ×435; **32.** basal cells of perichaetial leaf, ×170; **33.** perichaetial leaf cells, ×435; **34.** perichaetial leaf apex, ×170; **35.** spore, ×170. (1–10, *Magill* 6326; 11–17, *Rehmann* 426; 18–25, *Lorentz* 1877; 26–35, *Almborn* 5348).



Perichaetia terminal. *Leaves* erect to erect-spreading; ovate to oblong-ovate or elliptic, acuminate to subulate, 0,8–1,7 mm long; margins plane to weakly recurved above, irregularly crenulate, frequently hyaline above. *Costa* excurrent as hair-point; in section semi-circular or crescent-shaped, ventral surface flat, cells undifferentiated, substereids to stereids. *Laminal cells* irregular, rhomboidal to fusiform and trapezoidal, sometimes quadrate, 20–45 μm long, incrassate; basal cells irregularly rectangular, thin-walled, hyaline in marginal region. *Spores* 8–40 per capsule, irregularly rounded to polyhedral, 125–176 μm, smooth, pale yellow to yellow-orange. Fig. 20: 1–10.

This plant has been collected in the southwestern Cape, Sani Pass area of Lesotho and at Bloemfontein in the Orange Free State. Map 28.



MAP 28.— ● **Archidium capense**
× **Archidium amplexicaule**

Vouchers: *Magill* 4384, 4410, 6326.

The perichaetial leaves with plane, irregularly crenulate margins and costa excurrent as hair-point help to define this species. The leaves are frequently fragile and hyaline above.

9. **Archidium julicaule** *C. Müll.* in Hedwigia 38: 52 (1899); Snider in J. Hattori bot. Lab. 39: 153 (1975). Type: Cape, Cape Town, *Rehmann* 426 (S-PA, lecto.; PRE!), vide Snider (1975).

Plants loosely caespitose, yellow to yellow-green; terricolous. *Stems* 2–7 mm high, branching by subperichaetial innovations; in section central strand large, cells small, thin-walled, inner cortical cells in 2 rows, incrassate, outer cortical cells smaller, in 1–2 rows, incrassate. *Leaves* bract-like below, larger above, appressed; oblong-ovate, oblong or elliptical, (0,2–) 0,4 (–0,7) mm long; apex acute or mucronate; margins plane to slightly recurved below, irregularly denticulate, teeth single, upper lamina bistratose juxtacostally. *Costa* mucronate to short-excurrent; in section crescent-shaped, ventral surface flat, cells undifferentiated, incrassate or stereids. *Laminal cells* irregularly short-rectangular, rhombic, and short-rhomboidal, incrassate; basal cells rectangular, thin-walled to incrassate.

Perichaetia terminal. *Leaves* erect, concave; rounded-ovate or oblong-ovate, acuminate, 1,0–1,4 mm long; margins plane, entire or crenulate to irregularly denticulate. *Costa* percurrent to short-excurrent; in section semi-circular or crescent-shaped, ventral surface flat, cells undifferentiated, incrassate or stereids. *Laminal cells* irregularly short-rectangular to quadrate and rhombic or rhomboidal, 15–27 μm long, thin-walled to incrassate; basal cells rectangular to rhomboidal, thinner-walled, basal margins hyaline. *Spores* 16–36 per capsule, angular to polyhedral, 140–220 μm, smooth, yellowish. Fig. 20: 11–17.

This species is represented by a few specimens collected on sandy soil in the fynbos biome of the Cape Peninsula. The Rehmann collection 429b is apparently mixed since duplicates at several institutions have been given various names. Map 26.

Voucher: Type only.

The appressed leaves with irregularly denticulate margins and acute apices will help to identify this species.

10. **Archidium amplexicaule** *C. Müll.* in Linnaea 43: 346 (1881); Snider in J. Hattori bot. Lab. 39: 151 (1975). Type: Concepción del Uruguay, *Lorentz* 1877 (S-PA, lecto.!), vide Snider (1975).

Archidium chrysosporum Schimp. ex Jaeg. in Verh. St Gall. naturw. Ges. 1868–69: 67 (1869), nom. nud. Type: Cape, Saldanha Bay, sin. coll. (S-PA).

Plants gregarious or in tufts, yellowish; terricolous. *Stem* erect, 3–10 mm high, branching by subperichaetial, julaceous innovations; in section central strand small, cortical cells undifferentiated, in 3 rows. *Leaves* bract-like, distant below, crowded above, appressed to erect-spreading; ovate

to ovate-lanceolate, acuminate, 0,8–1,2 mm long; apex occasionally apiculate; margins plane or narrowly recurved, entire. *Costa* weak, percurrent. *Laminal cells* irregular, quadrate to rectangular or rhomboidal; basal cells rectangular.

Perichaetia terminal. *Leaves* erect; ovate to oblong-acuminate, 1,0–1,8 mm long, margins plane to narrowly recurved above, entire to slightly crenulate above. *Costa* weak, percurrent to short-excurrent, in section semi-circular, cells undifferentiated. *Laminal cells* irregular, rectangular and rhombic to rhomboidal, 23–36 μm long; basal cells irregularly rectangular, thin-walled, hyaline. *Spores* 8–36 per capsule, irregularly rounded to tetrahedral, 130–210 μm, smooth, yellowish. Fig. 20: 18–25.

This species occurs in South America and in the Flora area it is restricted to the southwestern Cape. Map 28.

Voucher: Type only.

Archidium amplexicaule is closely related to *A. andersonianum;* but is separated by its julaceous innovations, smaller ovate to oblong-ovate perichaetial leaves and percurrent costae.

11. **Archidium andersonianum** *Snider* in Bryologist 78: 158 (1975). Type: Cape, Stellenbosch Flats, *Almborn* 5348 (S-PA, holo.!).

Plants loosely caespitose, yellow-green; terricolous. *Stem* erect, 2–6 mm high, branching by subperichaetial innovations, in section inner cortical cells in 1–2 rows. *Leaves* bract-like below, larger above, erect to spreading, concave; ovate to oblong, acuminate, 1,1–1,3 mm long; margins plane to occasionally narrowly recurved above, entire to crenulate. *Costa* strong-excurrent as short hair-point; in section semi-circular, ventral surface flat, cells incrassate or stereids. *Laminal cells* irregular, fusiform to rhomboidal; basal cells rectangular.

Perichaetia terminal. *Leaves* erect, concave; broadly oblong-ovate, acuminate, 1,3–1,8 mm long; margins plane to narrowly recurved, entire to infrequently crenulate. *Costa* apiculate to excurrent as hair-point; in section semi-circular to crescent-shaped, ventral surface flat, ventral cells incrassate, dorsal cells smaller, incrassate or stereids. *Laminal cells* irregular, rhomboidal to fusiform, 50–75 μm long; rectangular at margin; basal cells irregularly rectangular to rhomboidal, hyaline in marginal region. *Spores* 12–52 per capsule, irregularly rounded-tetrahedral to polyhedral, 150–200 μm, smooth, yellow. Fig. 20: 26–35.

Endemic to the southwestern Cape, this species is represented by a single specimen, collected on sandy soil on the Cape Flats. Map 27.

Voucher: Type only.

Although similar in habit to *A. capense* and *A. muelleranum*, this species differs in the deltoid innovation leaves with costa ending in a strong hair-point and the larger, broadly oblong-ovate perichaetial leaves with narrower costae.

Insufficiently Known Species

Archidium laterale Bruch ex Krauss in Flora, Jena 29: 132 (1846). Type: Natal, Umslutie River, *Krauss* s.n. Sim (1926) placed this species in the synonomy of the Southern African species presently treated as *A. rehmannii* Mitt., although he did not see the type. Snider (1975), in his revision of *Archidium*, was unable to locate the type of *A. laterale* and it has not been found during this study.

DITRICHACEAE

Plants minute to medium-sized, in dense tufts or gregarious; terrestrial. *Stems* simple or branched, central strand present or absent. *Leaves* ovate, oval or oblong, acute to subulate. *Costa* strong, narrow or broad; in section round or flattened, generally with stereid bands. *Laminal cells* generally rectangular, smooth or occasionally papillose above; basal cells generally larger, rectangular; alar cells not distinct.

Seta straight or cygneous; capsule cleistocarpic or stegocarpic, long-exserted or immersed; peristome single or absent, teeth 16, fragile, cleft or irregularly perforated, papillose or striate, reddish; operculum rostrate; calyptra cucullate or mitriform.

The family comprises 19 genera of which 7 are known from Southern Africa.

1 Leaves distichous or tristichous:
  2 Leaves distichous, flexuose.....6. **Distichium**
  2 Leaves tristichous, rigidly appressed.....7. **Tristichium**
1 Leaves not in distinct rows:
  3 Plants small to minute, gregarious or in small groups; capsule immersed or exserted laterally on arcuate seta; peristome absent:
    4 Plants small; leaves appressed to erect-spreading; capsule immersed; seta straight .....1. **Pleuridium**
    4 Plants minute; leaves secund; capsule exserted laterally by arcuate seta:
      5 Leaf cells smooth; capsule stegocarpic; calyptra mitriform.....2. **Eccremidium**
      5 Upper leaf cells papillose; capsule cleistocarpic; calyptra cucullate....1. **Pleuridium**
  3 Plants small to medium, in dense tufts or gregarious; capsule long-exserted; peristome present:
    6 Plants glaucous; branched above; gregarious in caves and deep crevices....5. **Saelania**
    6 Plants dark green to yellowish green, infrequently branched, forming dense tufts or patches in open sites:
      7 Leaves short, apex acute; leaf cells quadrate; capsule curved, plicate when dry .....4. **Ceratodon**
      7 Leaves long, apex acuminate to subulate; leaf cells elliptical to rectangular; capsule straight, smooth when dry.....3. **Ditrichum**

1. PLEURIDIUM

Pleuridium *Rabenh.*, Deutschl. Kryptogamenfl. 2: 79 (1848), nom. cons.; Broth. in Natürl. PflFam. 10: 157 (1924); Sim, Bryo. S. Afr. 142 (1926). Lectotype species: *P. subulatum* (Hedw.) Rabenh., vide Snider & Margadant in Taxon 22: 691 (1973).

Plants minute to small, gregarious, yellowish green; terricolous. *Stems* erect, 1–3 mm tall, to 10 mm in sterile specimens. *Leaves* erect or patent, small, oval to ovate, acute to long-acuminate above. *Costa* percurrent. *Laminal cells* quadrate to rectangular, smooth or papillose.

Autoicous. Perichaetia terminal, leaves larger. *Capsule* cleistocarpic, sessile or laterally exserted, urn round to elliptical, exothecial cells distinct; spores papillose or spinose.

Although the 34 species of *Pleuridium* are generally restricted in distribution, the genus is known from all continents except Antarctica. The four Southern African species are endemic and have very restricted ranges.

1 Plants elongated, 5–10 mm tall; stems in section fluted, without central strand; leaf cells frequently prorate (obvious only in cross section) ..... 3. *P. ecklonii*

1 Plants small to minute, to 3 mm tall; stems in section entire, central strand present; leaf cells smooth or papillose:

2 Plants minute; upper leaf cells with several low, blunt papillae over lumen ..... 4. *P. papillosum*

2 Plants small; upper leaf cells smooth:

3 Leaves patent, apices acuminate from near stem base; capsule globose ..... 1. *P. pappeanum*

3 Leaves appressed, apices shorter below, gradually longer distally, capsule oval to elliptical .. 2. *P. nervosum*

1. **Pleuridium pappeanum** (*C. Müll.*) *Jaeg.* in Verh. St Gall. naturw. Ges. 1871–72: 373 (1872); Broth. in Natürl. PflFam. 10: 157 (1924); Sim, Bryo. S. Afr. 143 (1926). Syntypes: Cape, Swellendam, *Pappe* s.n.; Swellendam, *Ecklon* s.n. (BM!).

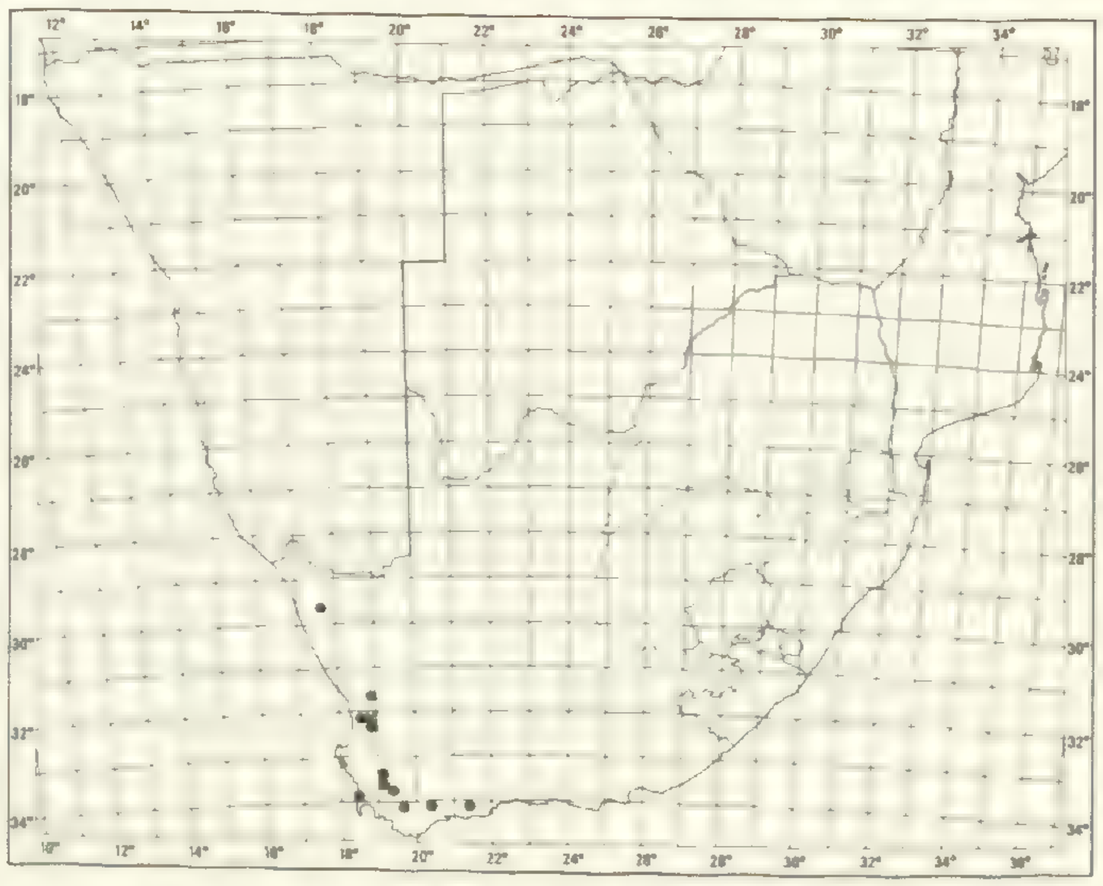
Astomum pappeanum C. Müll., Syn. Musc. 1: 15 (1848).

Astomum breutelianum Hampe ex C. Müll. in Bot. Ztg 17: 197 (1859). *Pleuridium breutelianum* (Hampe) Jaeg. in Verh. St Gall. naturw. Ges. 1871–72: 374 (1872); Broth. in Natürl. PflFam. 10: 157 (1924). Type: Cape, Gnadenthal, *Breutel* s.n. (BM!).

Bruchia rehmannii C. Müll. in Flora, Jena 71: 10 (1888). *Sporledera rehmannii* (C. Müll.) Kindb., Enum. Bryin. Exot. 95 (1889); Broth. in Natürl. PflFam. 10: 158 (1924). Type: Cape, Rondebosch, *Rehmann* s.n., Aug. 1875 (NH!).

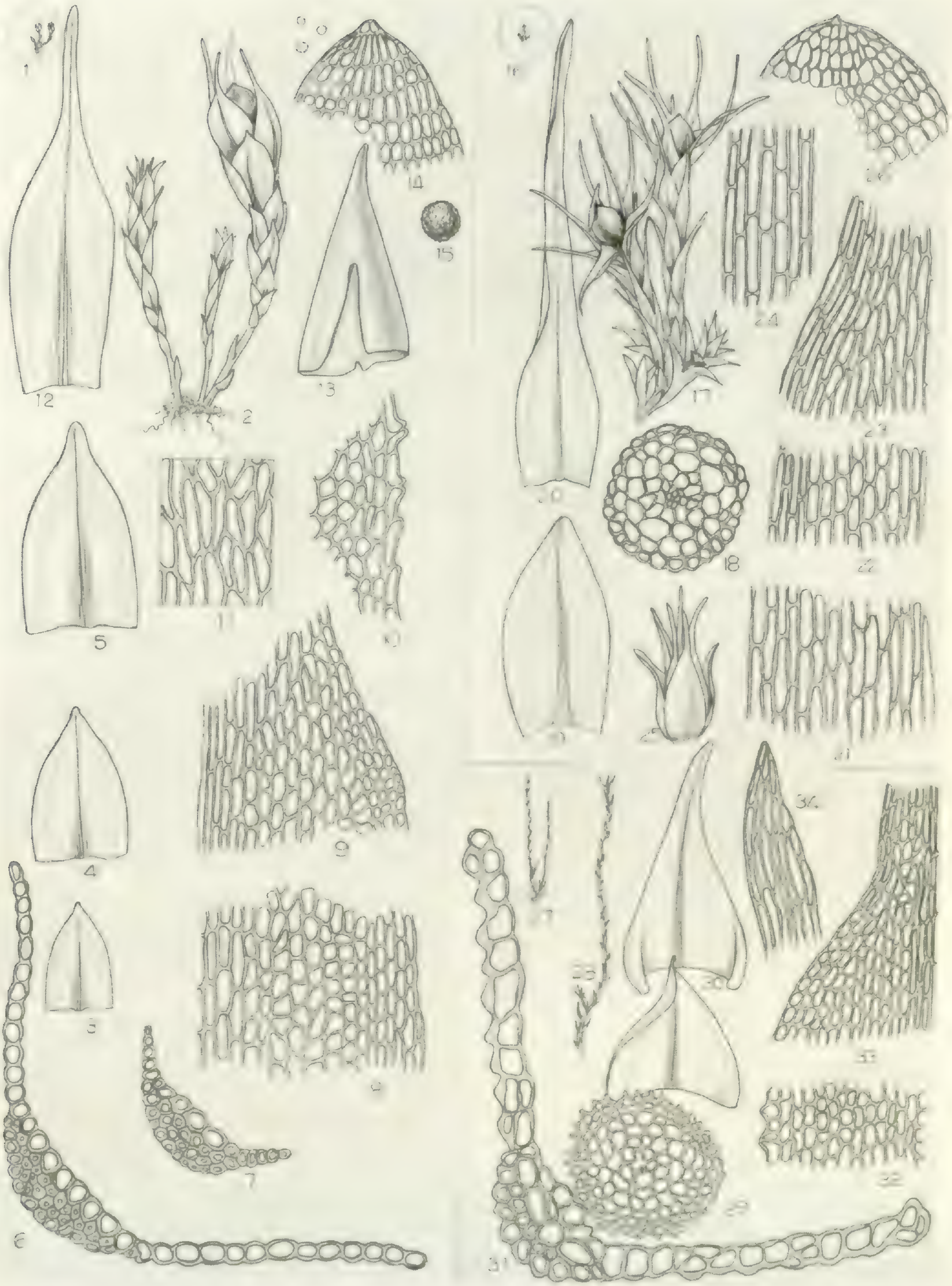
Plants small, gregarious, light to yellowish green; terricolous. *Stems* erect, to 3 mm tall, simple or branched below; in section with small central strand, cortical cells large, thin-walled, outer 1–2 rows slightly smaller, reddish brown. *Leaves* patent, lower leaves oval, 0,6–0,8 mm long; upper leaves oval to oblong, abruptly subulate, 1–2 mm long; apex acute; margins erect, entire. *Costa* percurrent; in proximal section guide cells exposed ventrally, dorsal cells in 2–3 rows, incrassate; in distal section guide cells 2–4, thickened, ventral cells in 2 rows, substereids, dorsal substereid band 2–3 cells thick, dorsal surface cells slightly larger. *Laminal cells* of lower leaves short-rectangular; in upper leaves linear above shoulders; basal cells long-rectangular.

Autoicous. *Perigonium* bud-like, axillary. *Perichaetial leaves* oval, gradually long-acuminate, 3,0–3,2 mm long; margins entire; costa percurrent; laminal cells linear above, oblong-hexagonal at shoulders; basal cells rectangular. *Seta* short, 0,1–0,2 mm long; capsule emergent, urn globose, 0,6–0,8 mm long, orange, very short-rostrate, exothecial cells quadrate to rectangular; calyptra cucullate; spores round, 17–20 μm, sparsely papillose. **Fig. 21: 16–26.**



MAP 29.— ● Pleuridium pappeanum
× Pleuridium papillosum

FIG. 21.—**Pleuridium nervosum** (1–15): **1.** habit, ×1; **2.** habit, ×10; **3–5.** leaves, ×40; **6.** leaf in proximal cross section, ×320; **7.** leaf in distal cross section, ×320; **8.** cells at basal margin, ×320; **9.** cells at upper margin, ×320; **10.** cells at upper margin of lower leaf, ×320; **11.** laminal cells of perichaetial leaf, ×320; **12.** perichaetial leaf, ×20; **13.** calyptra, ×50; **14.** exothecial cells at capsule apex and spores, ×50; **15.** spore, ×240. **P. pappeanum** (16–26): **16.** habit, ×1; **17.** habit, ×10; **18.** stem in cross section, ×150; **19.** lower stem leaf, ×40; **20.** upper stem leaf, ×40; **21.** basal leaf cells, ×320; **22.** laminal cells, ×320; **23.** marginal cells at base of subula, ×320; **24.** cells in leaf subula, ×320; **25.** perigonium, ×50; **26.** exothecial cells at capsule apex, ×50. **P. ecklonii** (27–34): **27.** habit, ×1; **28.** habit, ×2; **29.** stem in cross section, ×150; **30.** leaves, ×55; **31.** leaf in cross section, ×425; **32.** basal leaf cells, ×320; **33.** leaf cells at base of subula, ×320; **34.** leaf apex, ×435. (1–2, *Schelpe* 7785; 3–15, *Magill & Schelpe* 3987; 16–26, *Magill & Schelpe* 3920; 27–30, *Sim* 9259; 31–34, *Wager* 20).



Endemic to Southern Africa, *P. pappeanum* is infrequently found on thin sandy soils under brush in the western Cape. Recent collections have been made in the arid shrublands of Namaqualand, far north of the original collection sites near Swellendam. Map 29.

Vouchers: *Magill & Schelpe* 3820, 3859.

The abrupt change from acute to long-acuminate apices of the patent leaves on the lower stem and the globose capsule will define this species.

2. **Pleuridium nervosum** (*Hook.*) *Mitt.* in Hooker, J. Bot. Kew Gdn Misc. 8: 257 (1856); Broth. in Natürl. PflFam. 10: 157 (1924); Sim, Bryo. S. Afr. 15: 142 (1926). Type: Cape, *Menzies* s.n., 1791 (BM, holo.!).

Phascum nervosum Hook., Musci Exot. 2: 105 (1819). *Astomum nervosum* (Hook.) C. Müll. in Bot. Ztg 5: 98 (1847).

Plants small, in scattered groups, yellowish green; terricolous. *Stems* erect, julaceous, to 3 mm tall, simple; in section with small central strand, cortical cells incrassate, margin lobed. *Leaves* imbricate, lower leaves ovate to oval, 0,4–0,8 mm long, upper leaves oblong, to 1,2 mm long; apex obtuse to acute in lower leaves, gradually longer pointed to acuminate in upper leaves; margins irregularly serrate by projecting upper and/or lower cell ends. *Costa* percurrent in lower leaves, filling acumen in upper leaves; in section guide cells 5–8, large, ventrally exposed, dorsal stereid band small, dorsal surface cells large, strongly incrassate. *Upper laminal cells* of lower leaves subquadrate to short-rectangular becoming rhombic to rhomboidal in subperichaetial leaves; basal cells quadrate to rectangular in all leaves.

Autoicous. *Perichaetial leaves* broadly oval, abruptly short-acuminate, 2,2–2,5 mm long; margins serrulate at shoulders; costa percurrent; laminal cells rhombic to rhomboidal; marginal cells generally narrower, basal cells rectangular. *Seta* short, to 0,4 mm long; capsule immersed, urn oval to elliptical, 0,8 mm long, blackish red to yellowish red, obtuse to very shortly beaked, exothecial cells longitudinally short-rectangular; calyptra cucullate; spores round to triangular, 20–25 μm, papillose. Fig. 21: 1–15.

Known from Australia, New Zealand and Southern Africa, *P. nervosum* inhabits dry, open soils or shaded areas under brush, in the western, central and eastern Cape and Natal. In the western Cape, plants are frequently collected in association with *P. pappeanum*. Map 30.

Vouchers: *Giffen* PRE-CH4388; *Magill & Schelpe* 3987; *Smook* 1120.

This species is separated from the other species of *Pleuridium* by its julaceous stems, leaf apices gradually changing up the stem from acute to acuminate and the oval to short-oblong capsule. The spores are consistently larger and less highly ornamented than those of *P. pappeanum*.

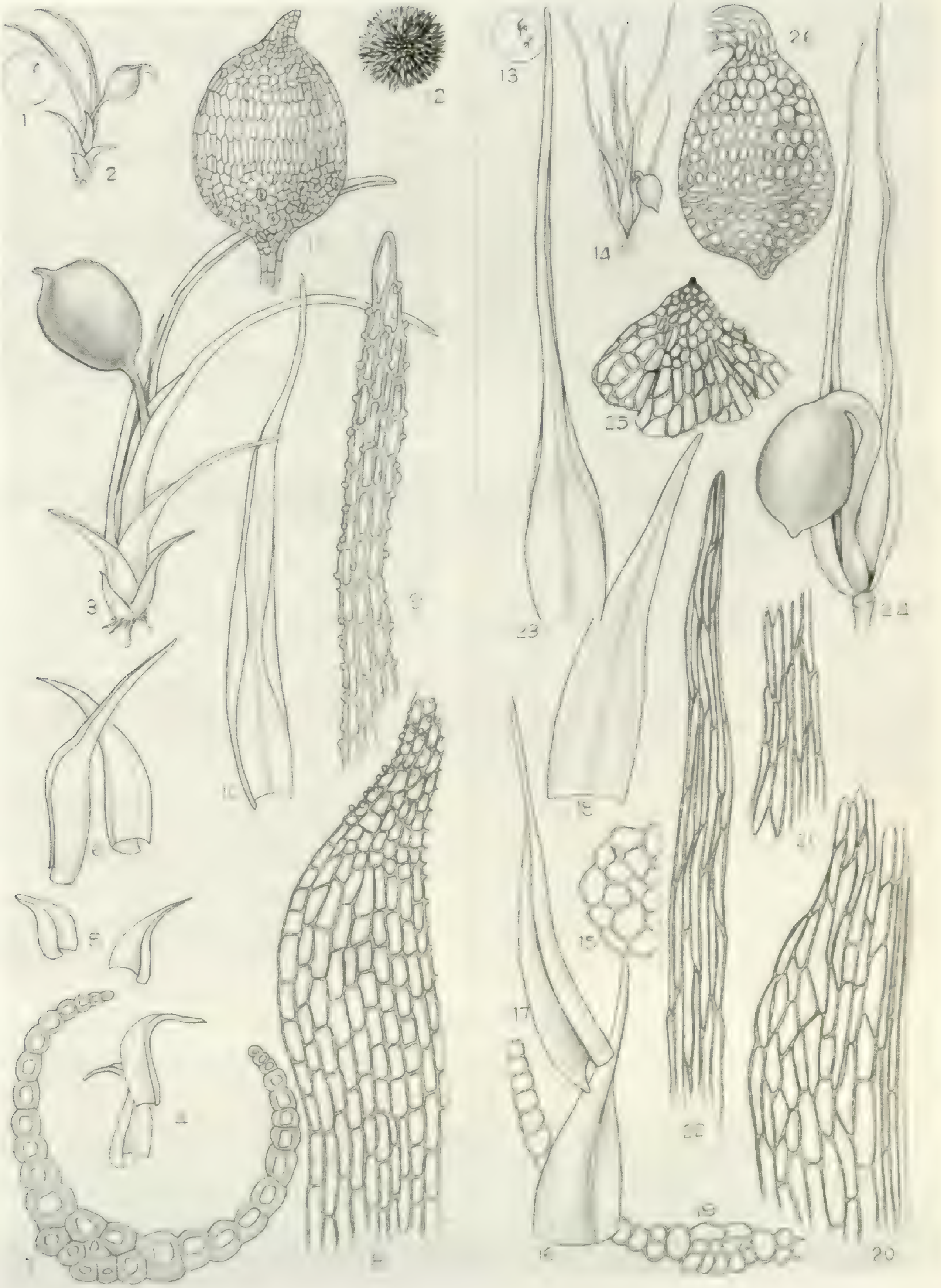
3. **Pleuridium ecklonii** (*C. Müll.*) *Snider* in J. Hattori bot. Lab. 39: 155 (1975). Type: Cape, Cape Town, *Naumann*, 1874 (BM, lecto.), vide Snider (1975).

Archidium ecklonii Hampe ex C. Müll. in Hedwigia 38: 53 (1899); Broth. in Natürl. PflFam. 1: 289 (1909); Sim, Bryo. S. Afr. 141 (1926).

Plants slender, forming intertwining tufts, green; terricolous. *Stems* erect, 5–10 mm high, simple, with leaves distant; in section without central strand, inner cortex of large, thin-walled cells, outer cortical cells in 2–3 rows, small, incrassate, reddish, margin fluted. *Leaves* patent, oval-acute to ovate-acuminate, 0,5–1,0 mm long; margins entire, recurved below. *Costa* percurrent, reflexed at tip of oval-acute leaves; in section guide cells 4, large, ventral cells incrassate, dorsal substereid band in single layer, dorsal surface cells incrassate. *Laminal cells* quadrate to rectangular, frequently weakly prorate; basal cells larger, rectangular.

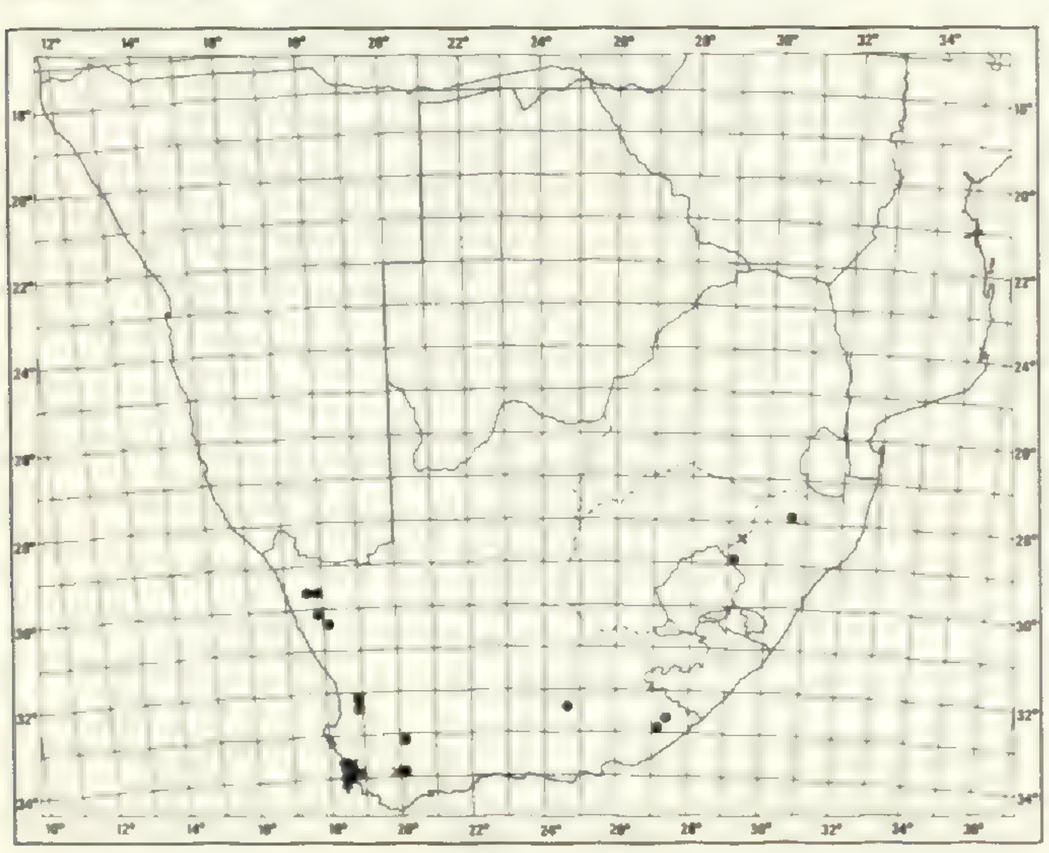
Sporophytes have not been found; Snider (1975) describes the perichaetial leaves as abruptly linear-subulate from a short-oval, sheathing base, one or two rows of marginal cells of the leaf base are narrower and more or less differentiated from marginal cells, the basal cells are faintly yellow-orange, and the lowermost row of basal cells is slightly inflated. The costa has guide cells and stereid cells in transection. Fig. 21: 27–34.

FIG. 22.—**Pleuridium papillosum** (1–12): **1.** habit, ×1; **2.** habit, ×10; **3.** habit, ×25; **4–6.** leaves, ×40; **7.** leaf in cross section, ×435; **8.** basal leaf cells, ×435; **9.** leaf apex, ×435; **10.** perichaetial leaf, ×40; **11.** capsule ×40; **12.** spore, ×380. **Eccremidium exiguum** (13–26): **13.** habit, ×1; **14.** habit, ×10; **15.** stem in cross section, ×240; **16–18.** leaves, ×40; **19.** leaf in cross section, ×435; **20.** basal leaf cells, ×170; **21.** cells at base of leaf subula, ×170; **22.** leaf apex, ×170; **23.** perichaetial leaf, ×40; **24.** sporophyte and perichaetial leaves, ×40; **25.** calyptra, ×60; **26.** capsule, ×60. (1–12, *Schelpe* 7624; 13–26, *Stone* s.n.).



This species has been occasionally collected in and around Cape Town since its original discovery by Breutel in 1858 and Naumann in 1874. A specimen collected by Wager in 1911 from Van Reenen, north-western Natal, has been verified, but it presents an unusual disjunction and may be in error. Map 30.

Vouchers: *Pillans* 4073; *Rehmann* 425; *Sim* 9259; *Wager* 85.



MAP 30.— ● **Pleuridium nervosum**
× **Pleuridium ecklonii**

The plants are quite distinct from other South African species. The elongated, fluted stems and small distant leaves easily divide the sterile specimens from *P. pappeanum* and *P. nervosum*. The change in leaf apices up the stem from acute to acuminate and back again, indicates several seasons' growth. Add to this stem anatomy and absence of sporophytic characters and it becomes clear that the present generic placement is doubtful. Until fertile material can be found, however, nothing can be done to solve the problem.

4. **Pleuridium papillosum** *Magill*, sp. nov., P. arnoldii (*R. Br. ter.*) *Par. foliis falcato-secundis setaque arcuata simile, sed cellulis papillosis subulae et sporis majoribus differt.*

Type: Cape, 11 km S of Clanwilliam on road to Algeria Forest Station, on clay bank, *Schelpe* 7624 (BOL, holo.; CINN; MO; PRE).

Plants minute, gregarious, yellowish green; terricolous. *Stems* very short, to 0,5 mm long, simple; in section round, central strand present, cortical cells large, in 3 rows, outer row reddish. *Leaves* spreading; lower leaves small, ovate-acute, 0,5–1,0 mm; upper and subperichaetial leaves oblong-acuminate, 1,0–1,8 mm long; apex reflected above clasping base; margins plane, crenulate above shoulders. *Costa* percurrent; in proximal section flattened, consisting of 5–6 substereid cells in 2–3 rows; in distal section rounded, of 8–10 substereid cells in 3 rows. *Laminal cells* rectangular in subula, papillose; elongate-hexagonal to rectangular at shoulders, increasing in size toward leaf base; in section gradually decreasing in size toward margin.

Perigonia not seen. Perichaetia terminal; leaves falcate-secund, linear-subulate, convolute, 2,2–3,0 mm long. *Seta* 0,5–0,6 mm long, yellow, arcuate in opposite direction to perichaetial leaves; capsule cleistocarpic, laterally exserted; urn ovoid, short-rostrate, 0,8 mm long, reddish yellow; exothecial cells quadrate proximally and distally, median cells rectangular; stomata present around capsule base; calyptra cucullate, small, covering upper capsule only, long-beaked, 0,5 mm long; spores round, 35–38 μm, spinose. Fig. 22: 1–12.

Endemic to South Africa. The only collection, so far known, comes from a clay road cutting south of Clanwilliam along the dirt road to Algeria Forest Station. Map 29.

Voucher: Type only.

The species is identified by its narrow leaves with clasping base and reflexed, papillose subula, and its laterally exserted capsule and large, spinose spores.

2. ECCREMIDIUM

Eccremidium *Hook. & Wils.* in Hooker's, Lond. J. Bot. 5: 450 (1846); Broth. in Natürl. PflFam. 10: 159 (1924); Scott & Stone, Moss. S. Aust. 125 (1976). Type species: Not designated.

Plants small to minute, gregarious; terricolous in open areas. *Stems* erect; central strand present. *Leaves* secund, oval-subulate; costa filling subula. *Laminal cells* oblong, smooth.

Monoicous. *Seta* short, curved; capsule operculate, laterally exserted, gymnostomous; calyptra mitriform.

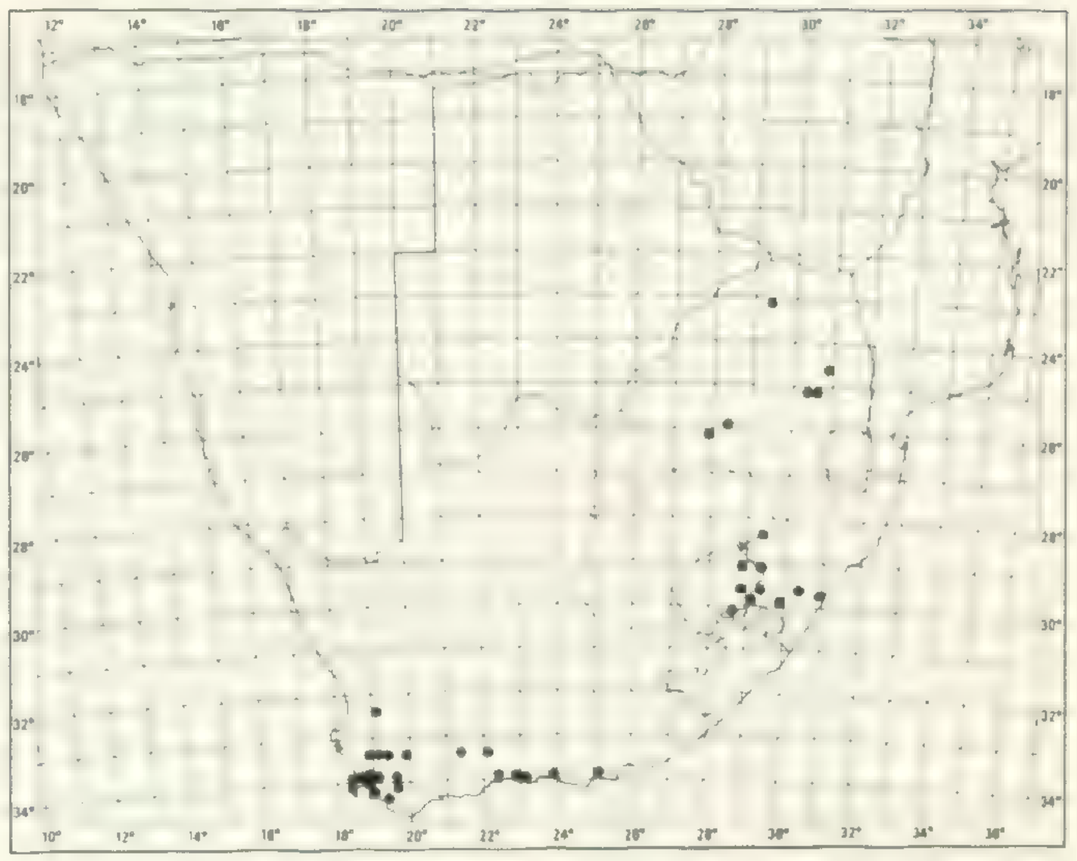
Eccremidium has 6 species, 5 endemic to Australia, the sixth, *E. exiguum*, is found in Australia and South Africa.

Eccremidium exiguum (*Hook. f. & Wils.*) *Wils. ex Salm.* in Rev. Bryol. 27: 85 (1900); Broth. in Natürl. PflFam. 10: 159 (1924); Scott & Stone, Moss. S. Aust. 125 (1976). Type: Australia, Swan River, *Drummond* s.n. (BM).

Phascum exiguum Hook. f. & Wils. in Hooker's Icon. Pl. 8: 737 B (1848).

Plants very small to minute, gregarious, light green; terricolous. *Stems* erect, 0,5 mm tall; in section round, central strand present, cortical cells very thin-walled, in 3–4 rows, outer row weakly thickened, reddish. *Leaves* secund; oval, long-subulate, 1,3–1,7 mm long; margins plane, entire. *Costa* filling subula; in section ventral cells thin-walled, in single layer, dorsal cells in 2 layers, cells smaller, incrassate. *Laminal cells* rectangular, thin-walled, cells of subula linear, incrassate, smooth.

Paroicous. *Perichaetia* terminal, leaves undifferentiated, 2,2 mm long. *Seta* arcuate, 0,8 mm long; capsule laterally exserted, pendent, ovoid, 0,8 mm long (immature), exothecial cells rounded-quadrate, incrassate, transversely elongate at mouth; peristome absent; operculum short-rostrate; calyptra mitriform; spores not seen. Fig. 22: 13–26.



MAP 31.— ● **Ceratodon purpureus**
× **Eccremidium exiguum**

The species, previously known only from Australia, was recently collected in the northern Drakensberg, at Royal Natal National Park. Map 31.

Voucher: *Stone* s.n., 23 Mar. 1972 (BOL!; MELU).

The small plants with secund leaves and pendent, operculate capsule are very distinctive. The plants could perhaps be confused with *Pleuridium papillosum*, but there the upper leaf cells are papillose and the capsules cleistocarpic.

3. DITRICHUM

Ditrichum *Hampe* in Flora, Jena 50: 181 (1867), nom. cons.; Broth. in Natürl. PflFam. 10: 161 (1924); Sim, Bryo. S. Afr. 145 (1926). Type species: *D. homomallum* (Hedw.) Hampe.

Plants small to large, in tufts, yellow-green to olive-green; terricolous. *Stems* erect, infrequently branched, with central strand. *Leaves* flexuose, narrow, acuminate to setaceous. *Costa* subpercurrent to excurrent, ventral stereid band present or absent. *Laminal cells* rectangular to quadrate, incrassate.

Autoicous. Perigonia gemmate, axillary; perichaetia terminal. *Seta* straight, long; capsule erect, elliptical or cylindrical, generally symmetrical; peristome teeth 16, lanceolate, divided to base or irregularly cleft or perforated, papillose; operculum rostrate; calyptra cucullate.

Ditrichum is a widespread genus with 87 species. There appears to be no concentration of species, each major continental area, except Antarctica, has 12–15 species. Sterile plants may be confused with *Dicranella* or other genera of the Dicranaceae, however the costal anatomy should identify *Ditrichum*. The cylindrical, non-furrowed capsule and papillose peristome will place fertile plants. Within Ditrichaceae, the long leaves, placed evenly around the stem, and rectangular cells of the long leaf subula, will define the genus.

Four species are presently recognized in Southern Africa. Exclusion of *D. amoenum* (Thwait. & Mitt.) Par. from the Flora and the placement of *D. hymenodontium* Dix. and *D. spirale* Dix. into synonomy were necessary because of the variability expressed by the gametophytes and the fragile nature of the peristome teeth.

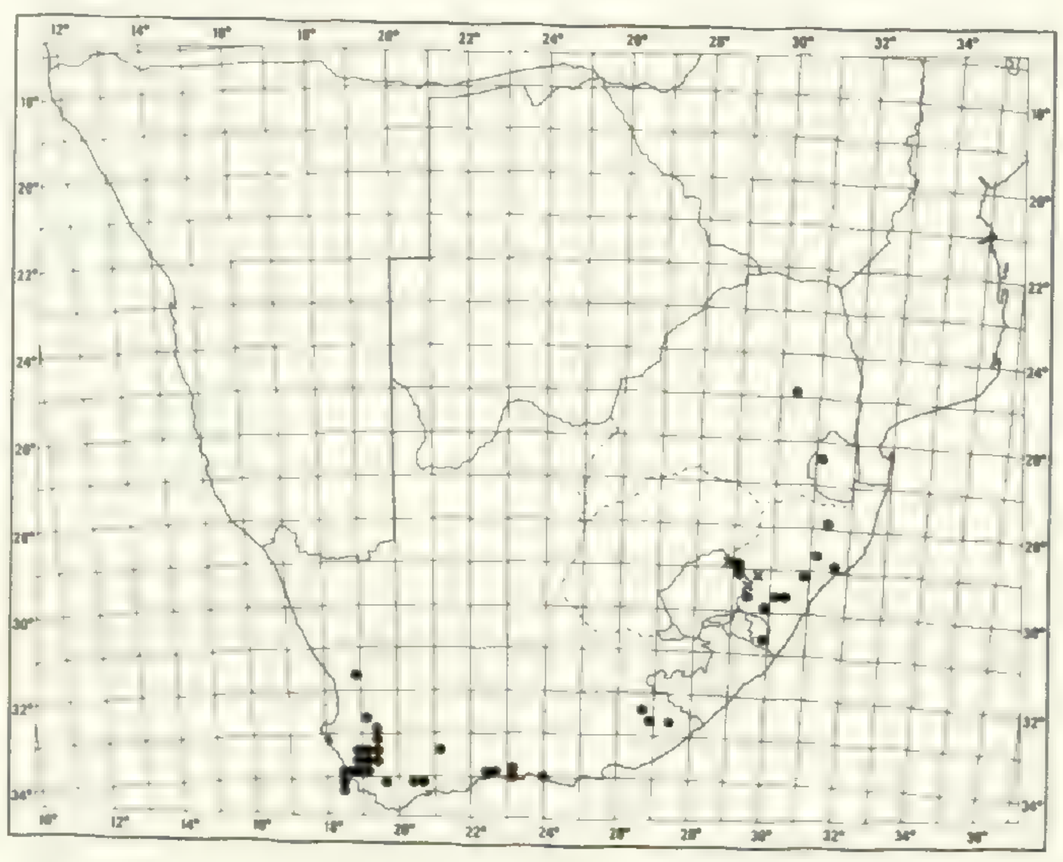
1 Cells of subula short-rectangular to elliptical:
2 Leaves 5,0–6,5 mm long; subula strongly twisted when dry.....2. *D. punctulatum*
2 Leaves 2,5–4,5 mm long; subula not twisted when dry.....1. *D. strictum*
1 Cells of subula rectangular to linear:
3 Seta short, 5–7 mm; capsule short-cylindrical, 1,0–1,5 mm long; leaves 1,0–2,5 mm long, patent.....3. *D. brachypodum*
3 Seta long, 10–20 mm; capsule cylindrical, 2,5–3,5 mm long; leaves 2,0–3,5 mm long, flexuose.....4. *D. difficile*

1. **Ditrichum strictum** (*Hook. f. & Wils.*) *Hampe* in Flora, Jena 50: 182 (1867); Broth. in Natürl. PflFam. 10: 162 (1924); Sim, Bryo. S. Afr. 147 (1926). Syntypes: Lord Auckland's group, ?*Hooker*; Campbell's Island, *Menzies* (BM!).

Lophiodon strictus Hook. f. & Wils. in Hooker, Lond. J. Bot. 3: 544 (1844).

Plants small to medium, in dense tufts, green to yellow-green above, brownish below; terricolous. *Stems* 20–30 mm high, infrequently branched, radiculose below; in section round, central strand small, cortical cells in 3–4 rows, outer row smaller, incrassate. *Leaves* erect to patent; subulate above oval base, 2,5–4,5 mm long; apex blunt, toothed; margins erect, entire below, toothed in upper subula; base weakly clasping, gradually narrowing to subula. *Costa* broad, filling subula; in proximal section sub-oval, guide cells 6–10, ventral stereid band 2–3 cells thick, ventral surface cells larger, incrassate, dorsal stereid band 2–4 cells thick, dorsal surface cells larger, incrassate or substereids. *Upper laminal cells* incrassate, elliptical to short-oblong in subula, rectangular at shoulders; basal cells long-rectangular, strongly thickened; basal marginal cells linear, thin-walled, hyaline.

Autoicous. Perichaetial leaves oblong-subulate, 4 mm long. *Seta* erect, 5 mm long, yellow; capsules oval to short-elliptical, 1,5–2,0 mm long; peristome fragile, short, teeth undivided, papillose; operculum rostrate, to 1 mm long; calyptra and spores not seen. Fig. 23: 21–27.



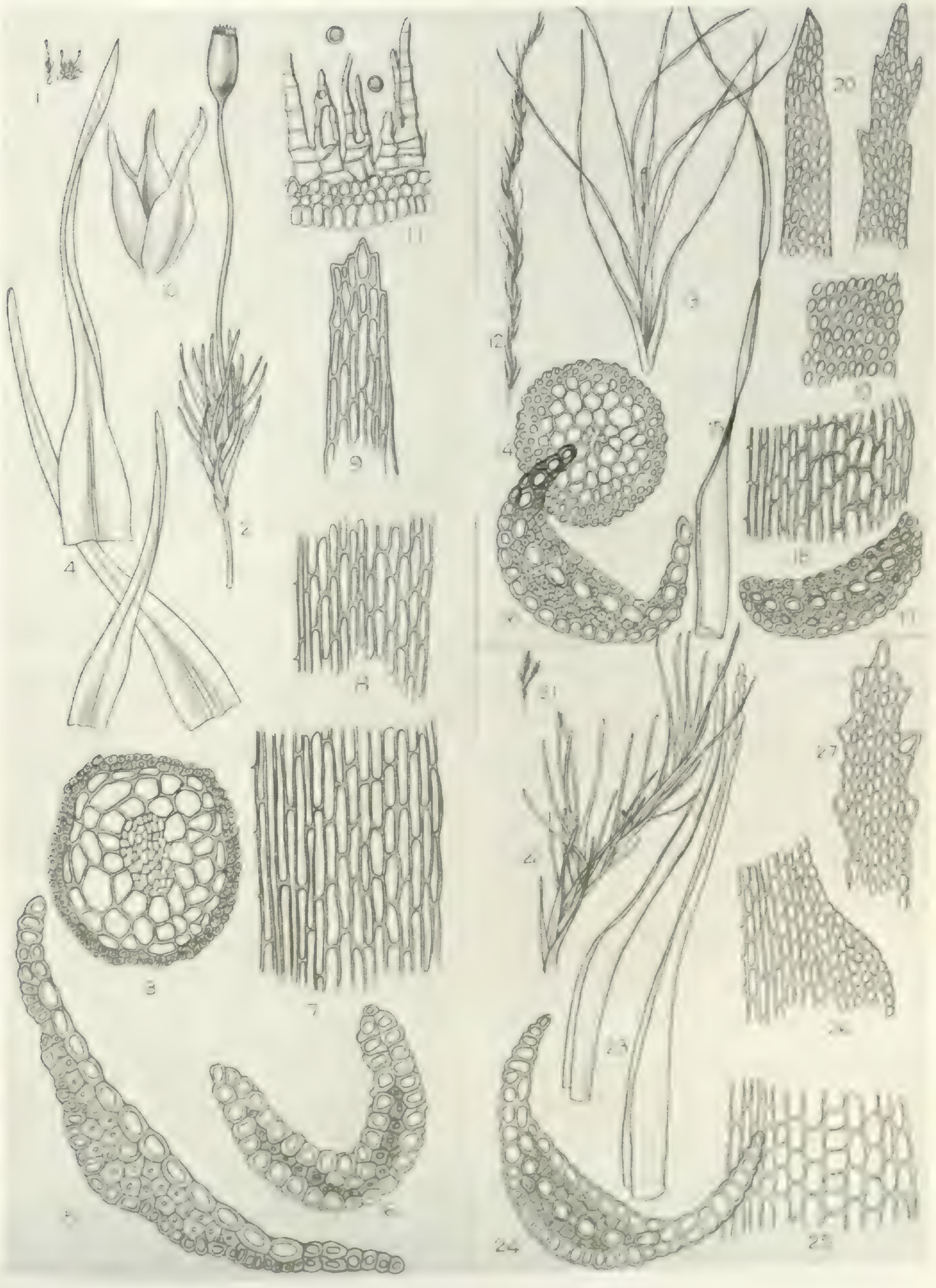
MAP 32.— ● **Ditrichum difficile**
× **Ditrichum strictum**

Although widespread on the subantarctic islands, this species is rare in Southern Africa. In the Flora area, *D. strictum* is known only from the Natal Drakensberg, above 5 500 m. Map 32.

Vouchers: *Sim* 8538, 8685.

This species is identified, in Southern Africa, by its short-elliptical upper leaf cells and straight, erect subula. *Ditrichum strictum* is related to several other species from New Zealand, Australia and the subantarctic islands, e.g. *D. punctulatum* and *D. cylindricarpum* (C. Müll.) F. Müll., but it lacks the pronounced leaf shoulders or spirally twisted subula exhibited by these species.

FIG. 23.—**Ditrichum brachypodum** (1–11): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×200; **4.** leaves, ×40; **5.** leaf in proximal cross section, ×370; **6.** leaf in distal cross section, ×370; **7.** basal leaf cells at margin, ×290; **8.** upper laminal cells at margin, ×290; **9.** leaf apex, ×290; **10.** perigonium, ×50; **11.** part of capsule mouth with peristome teeth and spores, ×167. **D. punctulatum** (12–20): **12.** habit, ×1; **13.** part of stem, ×10; **14.** stem in cross section, ×200; **15.** leaf, ×25; **16.** leaf in mid-leaf cross section, ×370; **17.** leaf in distal cross section, ×370; **18.** basal leaf cells at margin, ×200; **19.** upper laminal cells at margin, ×200; **20.** leaf apices, ×200. **D. strictum** (21–27): **21.** habit, ×1; **22.** part of stem, ×10; **23.** leaves, ×30; **24.** leaf in cross section, ×370; **25.** basal leaf cells at margin, ×170; **26.** laminal cells at shoulder, ×170; **27.** leaf apex, ×170. (1–3 & 10–11, *Rehmann* 86; 4–9, *Cholnoky* 520; 12–20, *Henderson* 232; 21–27, *Sim* 8538).



2. **Ditrichum punctulatum** *Mitt.* in Phil. Trans. R. Soc. 168: 25 (1879); Broth. in Natürl. PflFam. 10: 162 (1924); Sainsb., N. Zeal. Mosses 76 (1955); Seppelt & Stone in J. Bryol. 9: 321–325 (1977). Type: New Zealand.

Ditrichum spirale Dix. in Trans. R. Soc. S. Afr. 8: 181 (1920); Sim, Bryo, S. Afr. 148 (1926). Type: Cape, Gaika's Kop, Tjumie, *D., B. & M. Henderson* 232 (BM, holo.!; PRE!).

Plants medium to large, loosely caespitose, green to yellow-green; saxicolous. *Stems* 30–70 mm high, infrequently branched; in section central strand small, inner cortical cells in 2–3 rows, large, weakly thickened, outer cortical cells in 2 rows, smaller, strongly incrassate. *Leaves* flexuose to falcate, secund dry or wet; oval, abruptly or gradually contracted to a long, spirally twisted subula, 4,5–6,5 mm long; apex acute, toothed; margins erect to incurved, entire below, dentate in upper subula. *Costa* broad, filling subula; in proximal section flattened, guide cells small, 10–12, dorsal and ventral stereid bands 2–4 cells thick, surface cells not differentiated or occasionally substereids, laminal cells strongly thickened; in distal section reniform, guide cells small, 4–6, dorsal and ventral stereid bands 2–4 cells thick, surface cells occasionally substereids. *Laminal cells* variable in shape, elongate, sinuolate, strongly incrassate, abruptly quadrate at shoulders; short, rounded-rectangular in lower subula; basal cells long-rectangular, thin-walled toward margin.

Sporophyte not known from Africa. Fig. 23: 12–20.

Ditrichum punctulatum is known from Australia, New Zealand and South Africa. In Southern Africa the species has been collected in the Drakensberg of Natal and on Gaika's Kop in the eastern Cape. All collections were made in subalpine grassland above 5 500 m. Map 33.

Vouchers: *Esterhuysen* 18620; *Owen* 10.

The very long, spirally twisted subula will help to identify this species in Southern Africa. Variation is seen in the abruptness with which the leaves contract to the subula and in the extent of curvature of the leaves. *Ditrichum spirale* is a smaller plant but otherwise differs little from the typical form.

3. **Ditrichum brachypodum** (*C. Müll.*) *Broth.* in Natürl. PflFam. 1: 300 (1901); Sim, Bryo. S. Afr. 145 (1926). Type: Orange Free State, Kadziberg, *Rehmann* 86 (BOL!; NH!; PRE!).

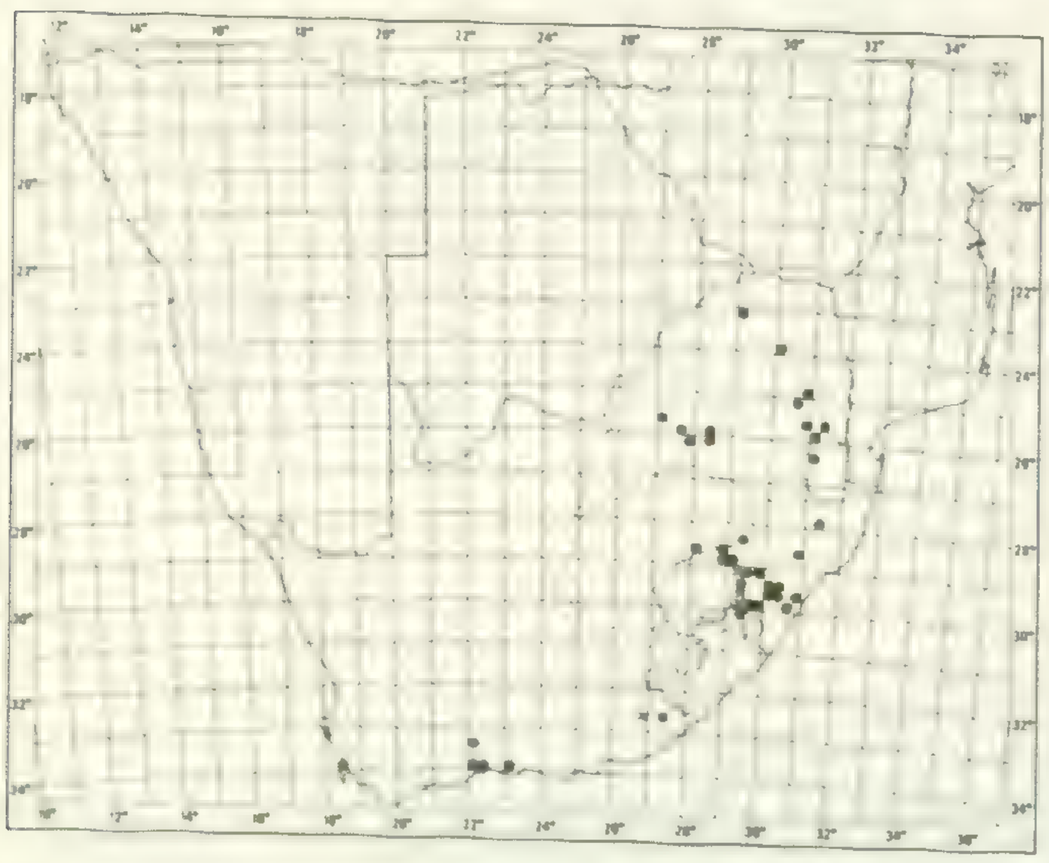
Leptotrichum brachypodum C. Müll. in Hedwigia 38: 89 (1899).

Leptotrichum brevifolium C. Müll. in Hedwigia 38: 88 (1899). *Ditrichum brevifolium* (C. Müll.) Broth., hom. illeg., in Natürl. PflFam. 1: 300 (1901), non (Kindb.) Par. (1896). Type: Transvaal, near Spitzkop, *Wilms* s.n., Apr. 1887 (G, holo.!).

Ditrichum hymenodontium Dix. in Trans. R. Soc. S. Afr. 18: 249 (1930). Type: Transvaal, Benoni, *Wager* 1005 (BM, holo.!).

Plants small, erect, yellowish green; terricolous. *Stems* 2–5 mm high, simple; in section round, central strand present, inner cortical cells large, thin-walled, outer cortical cells in 2 rows, stereids. *Leaves* patent, lamina narrow, bistratose above; oval to ovate, 1,0–2,5 mm long; apex acuminate; margin plane, entire to serrulate at apex. *Costa* broad, occupying ⅓ to ½ of leaf width, ending in acumen; in proximal section flattened, guide cells 10, exposed ventrally, large, incrassate, dorsal stereid band 1–2 cells thick, dorsal surface cells small, strongly incrassate; in distal section dorsal and ventral surface cells similar to laminal cells, incrassate, surrounding a single-layered median stereid band. *Laminal cells* rectangular or infrequently quadrate above, incrassate; basal cells larger, narrow-rectangular.

Autoicous. Perichaetial leaves ovate-acuminate, 2,5–3,5 mm long. *Seta* 5–7 mm long, yellow, reddish with age; capsule erect,



MAP 33.— ● Ditrichum brachypodum
× Ditrichum punctulatum

urn short-cylindrical, 1,0–1,5 mm long; peristome fragile, to 0,3 mm high, teeth irregularly thickened, deeply cleft, frequently with large perforations, papillose; operculum rostrate, 0,4 mm long; calyptra cucullate, 2,5 mm long; spores round, 14–18 μm, papillose. Fig. 23: 1–11.

Endemic to Southern Africa, *D. brachypodum* is frequently collected in Natal and the northern, central and eastern Transvaal. A few collections have also been made in Swaziland, the Orange Free State, and the eastern, southern and southwestern Cape. Growing on soil, the species is frequently collected along stream banks and in road cuttings. Map 33.

Vouchers: *Crosby & Crosby* 7495; *Rodin* 4532; *Sim* 9751.

The overall size of *D. brachypodum* generally separates it from the other larger species. The capsule is short-cylindrical and the seta is less than 10 mm long. The peristome is irregularly perforated, cleft and thickened, and generally very fragile. The type of *D. hymenodontium* consists of somewhat larger plants with peristomes almost intact, but conforms in all other characters to *D. brachypodum*. In Southern Africa the distributions of *D. difficile* and *D. brachypodum* are sympatric and they are frequently collected together in Natal. The former is more common in the Cape, while the latter ranges primarily northward into the Transvaal.

4. Ditrichum difficile (*Dub.*) *Fleisch.*, Musci Fl. Buitenzorg 1: 300 (1904); Scott & Stone, Moss. S. Aust. 112 (1976). Type: Java, *Zollinger* 411.

Trichostomum difficile Dub. in Moritzi, Syst. Verz. Zoll. Pfl. 134 (1846).

Ditrichum flexifolium Hampe in Flora, Jena 50: 182 (1867); Broth. in Natürl. PflFam. 10: 162 (1924); Sim, Bryo. S. Afr. 146 (1926). Type: Cape, *Menzies* s.n., 1791 (BM, holo.!).

Plants small to medium, in tufts, yellowish green; terricolous. *Stems* 7–12 mm high, simple; in section round, central strand present, inner cortical cells large, thin-walled, outer cortical cells in 2–3 rows, substereids. *Leaves* flexuose, oval to oblong, long-subulate, 1,8–3,5 mm long; margins plane to erect in subula, entire. *Costa* broad, filling subula; in proximal section flattened, guide cells 12–18, large, exposed ventrally or frequently with 2–3 ventral surface cells over central guide cells, dorsal stereid band 2–3 cells thick, dorsal surface cells not differentiated; in distal section guide cells 18–20, large, median, ventral stereid band 1–2 cells thick, ventral surface cells substereids, dorsal stereid band 2–4 cells thick, dorsal surface cells substereids, dorsal surface irregular. *Laminal cells* narrowly rectangular, incrassate; basal cells longer, oblong, incrassate.

Autoicous. Perichaetial leaves oblong, abruptly setaceous, 5,5–6,5 mm long. *Seta* 10–20 mm long, yellow to reddish yellow; capsule erect, urn cylindrical or broader below, 2,5–3,2 mm long; peristome fragile, teeth deeply cleft above short basal membrane into two narrow, papillose processes, rarely perforated below; operculum rostrate, 0,8 mm long; calyptra cucullate, 10 mm long; spores round, 17–18 μm, papillose. Fig. 24: 1–9.

Ditrichum difficile is known from Asia, Micronesia, India, East Africa, the Mascarenes and Southern Africa. In the Flora area, the species is frequently collected in the southwestern and southern Cape and Natal, but it has also been collected in the northwestern and eastern Cape, Zululand, Swaziland and the eastern Transvaal. Map 32.

Vouchers: *Crosby & Crosby* 8167; *Magill* 3527; *Magill & Schelpe* 3923; *Potts* 8541; *Sim* 9714.

This species is somewhat variable, but only a few collections have been difficult to place, since it is rarely found sterile. The leaves of *D. difficile* are considerably more flexuose than in any of the other three Southern African species. In addition, the cylindrical capsule on the very long seta, will identify this species in Southern Africa. The capsule length varies but does not overlap with the other species.

Ditrichum amoenum (Thwait. & Mitt.) Par. has been excluded from the Flora. The specimens recorded as this species in Southern Africa show a fragile, broken peristome, not the rudimentary peristome attributed to the Sri Lanka species. In fact, the peristomes of all Southern African specimens of *Ditrichum* proved quite fragile and also variable in the degree of perforation.

Insufficiently Known Species

Ditrichum capense (C. Müll.) O. Kuntze, Rev. Gen. Pl. 2: 835 (1891). Basionym: *Leptotrichum capense* C. Müll., Syn. Musc. 453 (1849). Syntypes: Cape, Van Kamp's Bay (Camps Bay), *Ecklon* s.n.; Natal, Port Natal (Durban), *Gueinzius* s.n. The syntypes have not been seen. Dixon in J. Bot., Lond. 51: 326 (1913) refers the species to *D. difficile* (Dub.) Fleisch.

Ditrichum vallis-gratiae (Lindb.) Hampe in Flora, Jena 50: 182 (1867). Basionym: *Diaphanophyllum vallis-gratiae* Lindb. in Öfvers. K. VetenskAkad. Förh. 19: 605 (1863). Type: Cape, Gnadenthal, *Breutel* s.n. The type has not been seen. Dixon in J. Bot., Lond. 51: 326 (1913) refers the species to *D. difficile* (Dub.) Fleisch.

4. CERATODON

Ceratodon *Brid.*, Bryol. Univ. 1: 480 (1826); Broth. in Natürl. PflFam. 10: 163 (1924); Sim, Bryo. S. Afr. 149 (1926). Lectotype species: *C. purpureus* (Hedw.) Brid., vide Britt., N. Amer. Fl. 15: 60 (1913).

Plants medium-sized, forming tufts; terricolous or saxicolous. *Stems* erect, with central strand. *Leaves* lanceolate; apex acute; margins revolute, serrate at apex. *Costa* percurrent; with dorsal and ventral stereid bands. *Laminal cells* generally quadrate, smooth.

Dioicous. *Seta* long; capsule cylindrical, erect to nodding, asymmetrical, strumose, furrowed dry; peristome teeth deeply cleft; operculum conical; calyptra cucullate.

A widespread genus with 19 species, *Ceratodon* is represented in Southern Africa by *C. purpureus*. Species of *Ceratodon* occur throughout temperate to alpine regions on all continents, including the Antarctic.

Ceratodon purpureus (*Hedw.*) *Brid.*, Bryol. Univ. 1: 480 (1826); Broth. in Natürl. PflFam. 10: 163 (1924); Sim, Bryo. S. Afr. 150 (1926). Type: Europe.

Dicranum purpureus Hedw., Spec. Musc. 136 (1801).

Ceratodon stenocarpus Bruch & Schimp. ex C. Müll., Syn. Musc. 1: 647 (1849); Broth. in Natürl. PflFam. 10: 163 (1924); Sim, Bryo. S. Afr. 150 (1926). Syntypes: Cape, Table Mountain, *Ecklon* s.n.; Neelgheriensibus, *Perrottet* s.n.; Mexico, *Liebmann* s.n.; Columbia, *Funck & Schlim* 473.

Plants medium-sized, in tufts, yellow-green, reddish below; terricolous or saxicolous. *Stems* 5–20 mm high, yellow to reddish, little branched, frequently tomentose below; in section central strand present, large, inner cortical cells large, thin-walled, outer cortical cells in 3 rows, substereids. *Leaves* incurved dry, spreading wet; ovate to lanceolate, 1,0–1,5 mm; apex acute to short-acuminate; margins narrowly revolute, entire to apex. *Costa* percurrent to short-excurrent; in section oval, guide cells 4, large, ventral stereid band 2–3 cells thick, ventral surface cells larger, incrassate, dorsal stereid band 3–4 cells thick, dorsal surface cells generally substereids or only incrassate. *Laminal cells* quadrate to short-rectangular, incrassate; basal cells generally rectangular.

Dioicous. Perichaetia terminal; leaves broad below, oblong, short-acuminate. *Seta* 15–25 mm long, yellow, reddish with age; capsule erect to inclined, oblong-cylindrical, asymmetrical, 1,0–1,2 mm long, strongly furrowed dry, strumose at base, yellow to purple-red; peristome teeth 16, lanceolate, divided to near base, divisions filiform with weak nodes above, slightly papillose throughout, orange below, hyaline above; operculum conical, 0,5 mm long; calyptra cucullate; spores round, 10,0–12,5 μm, smooth. Fig. 24: 10–19.

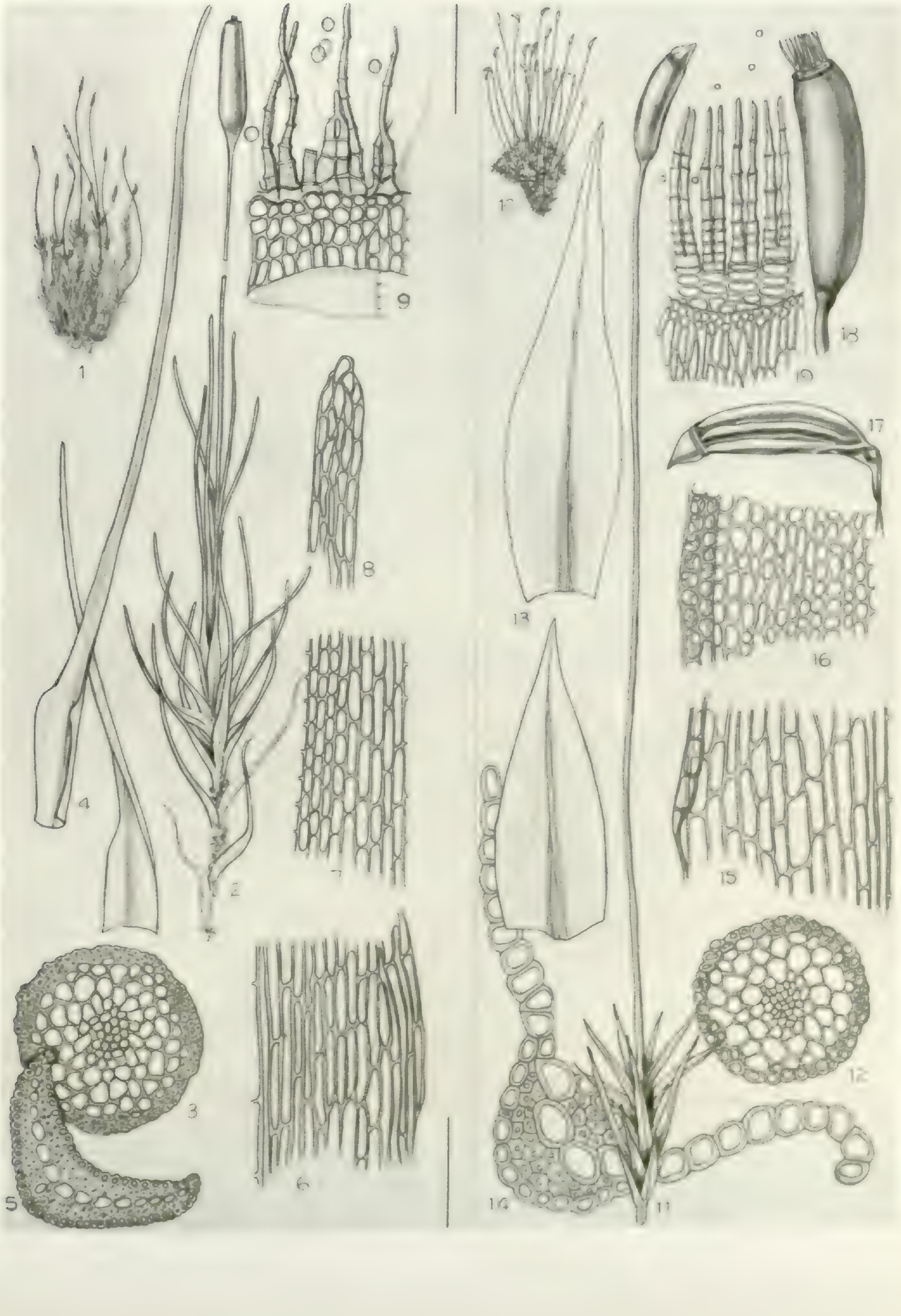
Almost cosmopolitan in distribution. In Southern Africa, *C. purpureus* is common in the southwestern and southern Cape and is infrequently collected in Natal, Lesotho and Transvaal. The ecological tolerance of this species is quite wide, resulting in a good deal of variation in plant size. Map 31.

Vouchers: *Crosby & Crosby* 8625; *Esterhuysen* 17301, 20228; *Haygarth* 32; *Magill* 4316.

Although somewhat variable, the strongly plicate, generally inclined capsule of *C. purpureus* characterizes the plant. Sterile plants are most easily recognized by the evenly quadrate laminal cells and revolute margins of the leaves.

Ceratodon stenocarpus is treated as a synonym of *C. purpureus*; however, its status is still problematical. There exist in Southern Africa, mostly in the Cape Province, populations answering to the characters generally ascribed to *C. stenocarpus*, i.e. erect, yellow

FIG. 24.—**Ditrichum difficile** (1–9): **1.** habit, ×1; **2.** habit, ×6; **3.** stem in cross section, ×200; **4.** leaves, ×40; **5.** leaf in distal cross section, ×370; **6.** basal leaf cells at margin, ×170; **7.** upper laminal cells, ×170; **8.** leaf apex, ×170; **9.** part of capsule mouth with peristome teeth and spores, ×125. **Ceratodon purpureus** (10–19): **10.** habit, ×1; **11.** habit, ×10; **12.** stem in cross section, ×140; **13.** leaves, ×40; **14.** leaf in cross section, ×600; **15.** basal leaf cells at margin, ×435; **16.** upper laminal cells at margin, ×435; **17.** operculate capsule, dry, ×40; **18.** deoperculate capsule, wet, ×40; **19.** part of capsule mouth with peristome teeth and spores, ×125. (1–9, *Cholnoky* 1122; 10–19, *Cholnoky* 69).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capsule on long, yellow seta (vide Gangulee, 1971; Grout, 1936). However, there also exist populations intermediate in stature (from erect to inclined), colour (from yellow to red-purple) and plication (from smooth to deeply grooved). As no clear separation could be obtained and because no major gametophytic differences occur, the specimens are all treated under *C. purpureus*.

5. SAELANIA

Saelania *Lindb.*, Utkast Nat. Grupp. Eur. Bladmoss. 35 (1878); Broth. in Natürl. PflFam. 10: 163 (1924); Sim. Bryo. S. Afr. 148 (1926). Type species: *S. caesia* (P. Beauv.) Lindb.

Plants small to medium, gregarious, glaucous; terricolous. *Stems* erect, branched, central strand large. *Leaves* lanceolate, subulate to acuminate; margins serrate in acumen, plane above, recurved below. *Costa* percurrent to short-excurrent, with dorsal and ventral stereid bands. *Laminal cells* short-rectangular.

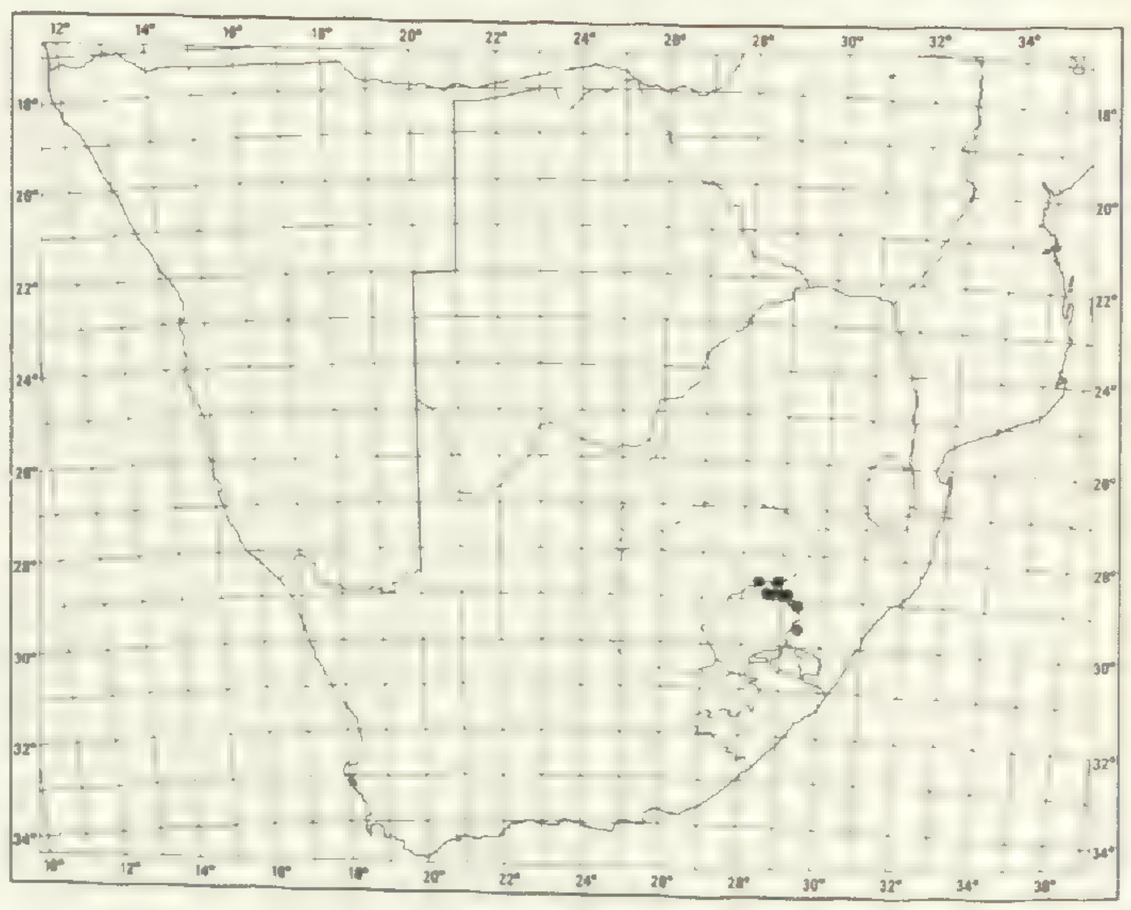
Autoicous. *Seta* long; capsule erect, elliptical; peristome teeth divided to base, densely papillose; calyptra cucullate.

Saelania is a monotypic genus found on soil of rock crevices and in shallow caves throughout alpine and subarctic regions of the Northern Hemisphere. In the Southern Hemisphere, it is known from similar habitats, at high altitudes, in Southern Africa and New Zealand.

Saelania glaucescens (*Hedw.*) *Broth.* in Bomanss & Broth., Herb. Mus. Fenn. 2: 53 (1894); Broth. in Natürl. PflFam. 10: 163 (1924); Sim, Bryo. S. Afr. 148 (1926). Type: Sweden, *Swartz* s.n.

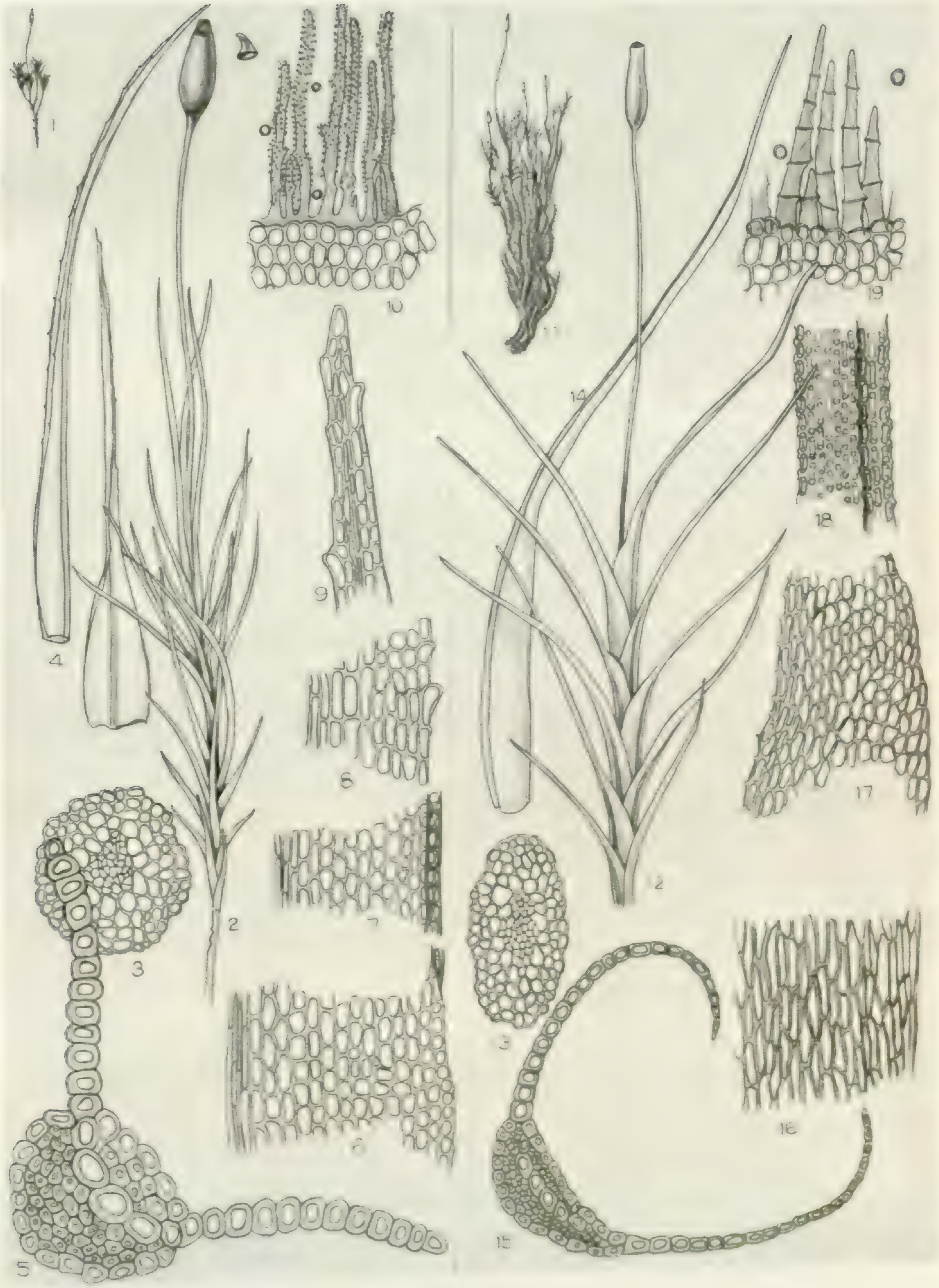
Trichostomum glaucescens Hedw., Spec. Musc. 112 (1801). *Ditrichum glaucescens* (Hedw.) Hampe in Flora, Jena 50: 182 (1867).

Plants small, gregarious, blue-green, covered with bluish 'bloom'; on soil over rock. *Stems* erect, 5–10 mm high, branched above; in section with large central strand, inner cortical cells enlarged, thin-walled, outer cortical cells small, incrassate, in three layers. *Leaves* erect-flexuose dry, patent wet; lanceolate-subulate, 2,5–3,5 mm long; apex acute; margins plane above, reflexed at mid-leaf, irregularly serrate above. *Costa* excurrent; in section guide cells 4, large, ventral stereid band to 3 cells thick, ventral surface cells larger, incrassate, dorsal stereid band large, 5–6 cells thick, dorsal surface cells larger, incrassate. *Laminal cells* rectangular to quadrate throughout, somewhat incrassate, some upper lamina cells prorate.



MAP 34.— ● **Saelania glaucescens**
× **Blindia magellanica**

FIG. 25.—**Saelania glaucescens** (1–10): **1.** habit ×1; **2.** habit, with capsule and detached operculum, ×10; **3.** stem in cross section, ×110; **4.** leaves, ×40; **5.** leaf in cross section, ×380; **6.** basal leaf cells at margin, ×250; **7.** laminal cells at margin (dorsal surface), ×250; **8.** upper laminal cells at margin, ×250; **9.** leaf apex, ×250; **10.** part of capsule mouth with peristome teeth and spores, ×160. **Distichium capillaceum** (11–19): **11.** habit, ×1; **12.** habit, ×10; **13.** stem in cross section, ×160; **14.** leaf, ×40; **15.** leaf in proximal cross section, ×270; **16.** basal leaf cells, ×320; **17.** laminal cells at margin, ×320; **18.** cells in leaf subula, ×320; **19.** part of capsule mouth with peristome teeth and spores, ×160. (1–10, *Magill* 4584; 11–19, *Esterhuysen* 26184).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Autoicous. Perigonia terminal on short lateral branches. Perichaetia terminal; leaves subulate above oval base, 4–5 mm long. *Seta* straight, 6–8 mm long; capsule erect, elliptical, 1,0–1,5 mm long, weakly grooved dry, yellow-brown; exothecial cells rounded-rectangular, quadrate at mouth; peristome 0,25 mm high, teeth divided to base into two linear processes, occasionally irregular, strongly papillose, red-brown; operculum long-rostrate, 0,5–0,8 mm long; calyptra cucullate; spores 17–20 μm, round, papillose. Fig. 25: 1–10.

This widespread, high altitude species is known from Europe, Asia, North America, New Zealand and South Africa. In Southern Africa the species is found in the grass-heath biome in the Drakensberg of Natal, Lesotho and the Orange Free State. Map 34.

Vouchers: *Magill* 4586, 4589; *Symons* 8681; *Wager* 86.

The plants can be identified by their bluish 'bloom' and erect, branching stems. In addition they are restricted to shallow soils in small caves or recesses at high altitudes.

6. DISTICHIUM

Distichium *B.S.G.*, Bryol. Eur. 2: 153 (1846); Broth. in Natürl. PflFam. 10: 164 (1924); Sim, Bryo. S. Afr. 149 (1926). Lectotype species: *D. capillaceum* (Hedw.) B.S.G., vide Grout, Moss Fl. N. Amer. 1: 38 (1936).

Plants slender, in dense tomentose tufts; saxicolous. *Stems* elongate, densely tomentose below, with central strand. *Leaves* distichous, oblong-subulate; base sheathing. *Costa* excurrent, with dorsal and ventral stereid band. *Laminal cells* subquadrate to rectangular, prorate.

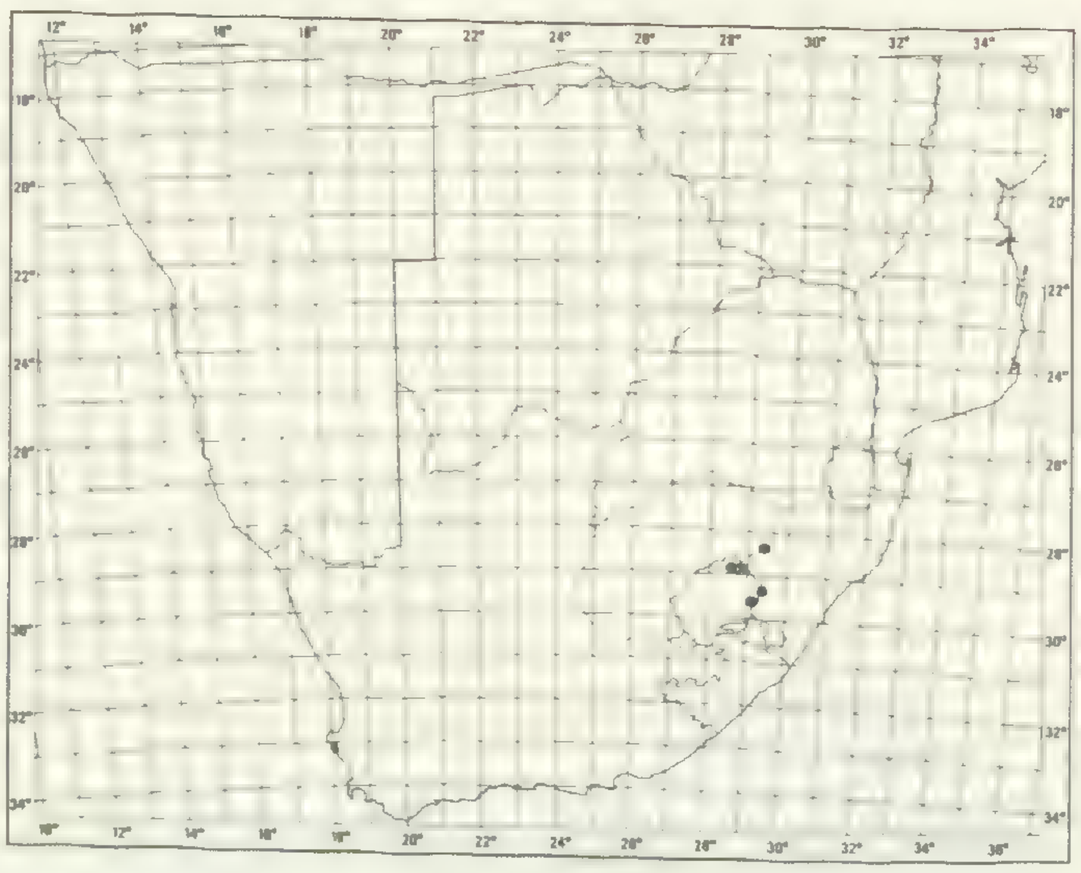
Autoicous. *Seta* long; capsule erect, cylindrical, symmetrical; peristome teeth irregularly cleft or perforated, lightly striate; operculum rostrate; calyptra cucullate.

The genus comprises 16 species, generally of Northern Hemisphere distribution. The single Southern African species, *D. capillaceum*, is by far the most widespread species in the genus, being found on every continent. In Southern Africa all the recent collections have been made at high altitudes in the Drakensberg.

Distichium capillaceum (*Hedw.*) *B.S.G.*, Bryol. Eur. 2: 156 (1846); Broth. in Natürl. PflFam. 10: 164 (1924); Sim, Bryo. S. Afr. 149 (1926). Type: France.

Cynontodium capillaceum Hedw., Spec. Musc. 57 (1801).

Plants medium to large, slender, forming dense tufts, green above, brown below; saxicolous. *Stems* erect, 10–30 mm high, branching above, densely tomentose below; in section elliptical, central strand present, inner cortical cells in single row, large, thin-walled, outer cortical cells in 2–3 rows, smaller, incrassate. *Leaves* distichous, appressed with squarrose-flexuose tips wet or dry; oblong, abruptly long-subulate, 3–4 mm long; apex acute, occasionally weakly toothed; base clasping stem, to 1 mm long; margins weakly convolute below. *Costa*



MAP 35.— ● **Distichium capillaceum**
× **Tristichium mirabile**

excurrent; in section flattened, guide cells 6–8, small, incrassate, ventral stereid band small, to 3 cells thick, ventral surface cells substereids, dorsal stereid band 4–8 cells thick, dorsal surface cells substereids, with strongly thickened outer walls. *Upper laminal cells* rectangular, strongly prorate, at shoulders irregular, triangular to quadrate, smooth; basal cells long-rectangular to oblong-hexagonal, linear below.

Autoicous. Perichaetia terminal; leaves undifferentiated, base to 2 mm long. *Seta* erect, 6–12 mm long; capsule erect, symmetrical, cylindrical, 1,0–1,2 mm long, yellowish; exothecial cells rectangular, quadrate at mouth; peristome teeth 0,2 mm high, divided to near base or only perforated below, lightly striate, red-yellow; operculum rostrate; calyptra cucullate; spores round, 16–20 μm, punctate. Fig. 25: 11–19.

This widespread species was treated as a doubtful record by Sim (1926), but recent collections from the Natal Drakensberg and Lesotho confirm its presence in the Flora. Map 35.

Vouchers: *Esterhuysen* 26184; *Magill* 4530; *Smook* 1099.

The Southern African specimens have been collected on rock, at high altitude. The distichous leaf arrangement and the strongly prorate cells of the subula should easily place specimens both within the family and the genus.

7. TRISTICHIUM

Tristichium *C. Müll.* in Linnaea 42: 435 (1879); Herzog in Flora, Jena 107: 322 (1914); Broth. in Natürl. PflFam. 10: 164 (1924). Type species: *T. lorentzii* C. Müll.

Plants slender, in tufts; saxicolous. *Stems* erect, branching; central strand present. *Leaves* tristichous, rigidly appressed, linear; base sheathing. *Costa* percurrent, with dorsal stereid band. *Laminal cells* linear, incrassate, smooth.

Autoicous. *Seta* short, erect to curved; capsules cleistocarpic or stegocarpic, gymnostomous, oval to cylindrical; operculum obliquely rostrate; calyptra cucullate.

New to Africa, *Tristichium* was previously known only from South America. Although very similar gametophytically, the two South American species are separated by their cleistocarpic [*T. lorentzii* C. Müll.] or stegocarpic [*T. mirabile* (C. Müll.) Herz.] capsules and different spore sizes. In Southern Africa the genus has recently been collected on rock at high altitude in Lesotho.

Tristichium mirabile (*C. Müll.*) *Herz.* in Flora, Jena 107: 324 (1914); Broth. in Natürl. PflFam. 10: 164 (1924). Type: Argentina, *Lorentz* s.n.

Tristichiopsis mirabilis C. Müll. in Linnaea 43: 394 (1882).

Plants medium-sized, slender, in tufts, light green to yellow-green; saxicolous. *Stems* 10–15 mm high, branching above, weakly radiculose below; in section subtriangular, central strand small, inner cortical cells in 2–3 rows, varying in size, thin-walled, outer cortical cells in 2 rows, stereids, dark red. *Leaves* tristichous, rigidly appressed wet or dry, small and distant below, larger and crowded above; linear to narrowly triangular, 0,8–1,2 mm long, ventral surface broadly channelled to keeled; apex acute; base sheathing stem; margins erect, entire. *Costa* percurrent, superficial cells linear, smooth; in section ventrally concave, guide cells 12–16, exposed ventrally, incrassate, smooth, dorsal stereid band 1(–2) cells thick across costa, dorsal surface cells slightly larger, strongly incrassate, smooth. *Upper laminal cells* linear, incrassate, smooth; basal cells similar, weakly thickened, reddish yellow at insertion.

Gonioautoicous. Perigonia gemmate, axillary on upper stem; leaves oval-acuminate, 0,6–0,7 mm long. Perichaetia terminal; leaves convolute, oblong-subulate, 1,2 mm

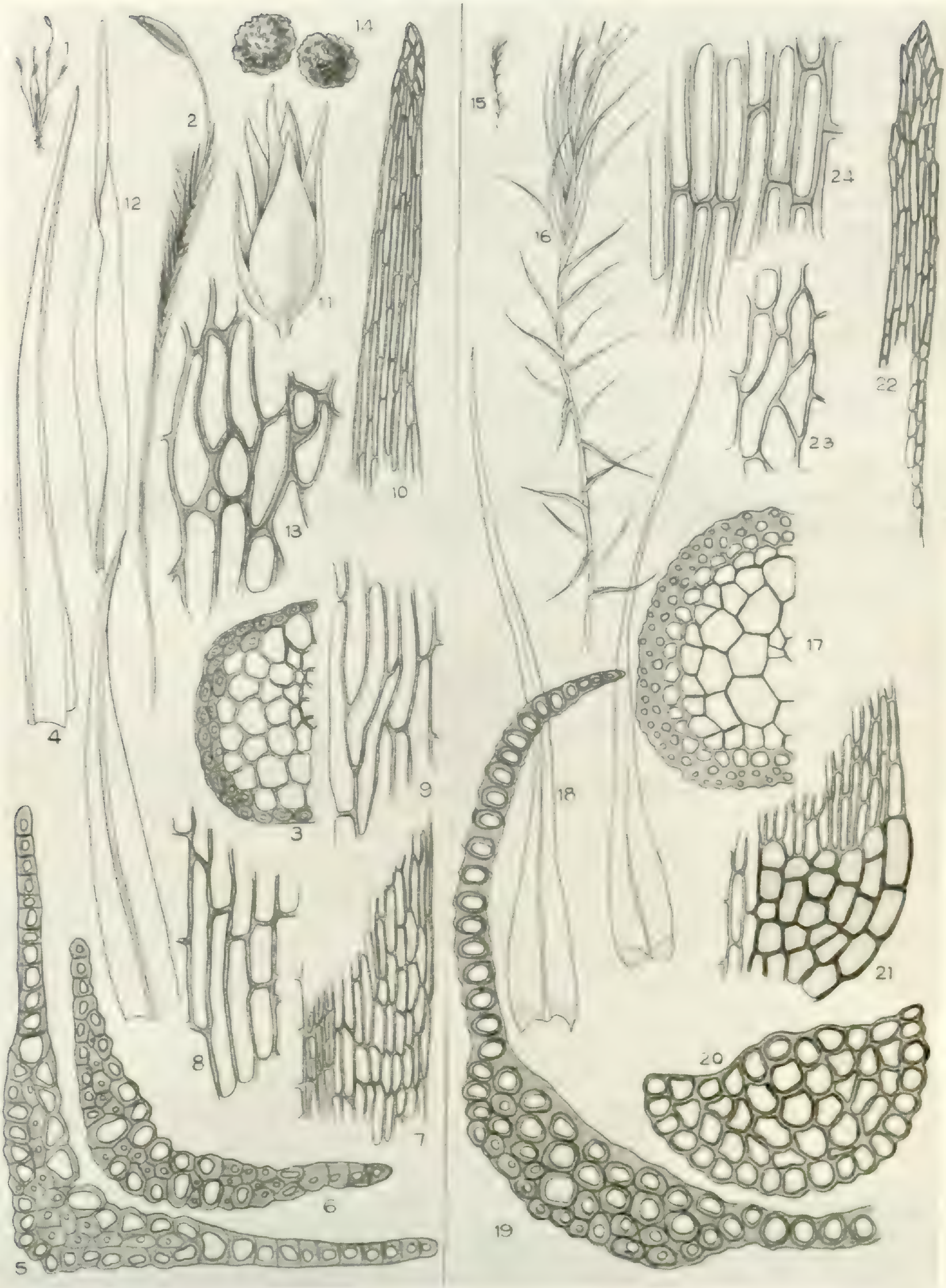
long; costa filling subula. *Seta* erect to somewhat curved dry, 4 mm long, yellow to brownish; capsules erect to curved, ± asymmetrical, 1,5 mm long, smooth, brownish; exothecial cells thickened; stomata not seen; annulus revoluble; peristome absent; operculum obliquely rostrate, 0,5 mm high, cells not twisted; calyptra cucullate, small; spores round, 20–25 μm, coarsely papillose, brownish. Fig. 26: 1–14.

The species has only recently been discovered in the moist alpine to subalpine grasslands of Lesotho. Map 35.

Vouchers: *Van Zanten* 7609943a, 7609957, 7609984.

Although occasionally inconspicuous because of branching or development of perichaetia, the distinctly tristichous arrangement of the closely appressed, linear leaves will separate this species from all other Southern African taxa. The character is most easily observed on sterile, unbranched stems.

FIG. 26.—**Tristichium mirabile** (1–14): **1.** habit, ×1; **2.** habit, ×5; **3.** stem in cross section, ×320; **4.** leaves, ×65; **5.** leaf in proximal cross section, ×640; **6.** leaf in distal cross section, ×640; **7.** cells at leaf base (right side), ×170; **8.** lower laminal cells, ×640; **9.** upper laminal cells, ×640; **10.** leaf apex, ×170; **11.** perigonium, ×65; **12.** perichaetial leaf, ×65; **13.** exothecial cells, ×640; **14.** spores, ×400. **Blindia magellanica** (15–24): **15.** habit, ×1; **16.** habit, ×5; **17.** stem in cross section, ×320; **18.** leaves, ×25; **19.** leaf in proximal cross section, ×640; **20.** leaf in distal cross section, ×640; **21.** basal leaf cells at right margin, ×170; **22.** leaf apex, ×170; **23.** upper laminal cells, ×640; **24.** basal laminal cells, ×640. (1–14, *Van Zanten* 7609884; 15–24, *Van Zanten* 76091012).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SELIGERIACEAE

Plants very small to medium, gregarious or loosely caespitose; saxicolous. *Stems* simple or branching; central strand present. *Leaves* erect to falcate-secund; generally subulate above broader base; margins entire to serrulate. *Costa* percurrent to excurrent, occasionally filling subula; in section cells not strongly differentiated. *Laminal cells* rectangular to linear, smooth; basal cells generally longer; alar cells not distinct or strongly differentiated.

Perichaetial leaves somewhat larger. *Seta* erect to cygneous; capsule small, ovoid to ellipsoid or pyriform, often with broad mouth; peristome single; operculum rostrate; calyptra cucullate; spores essentially smooth.

A small family of seven genera, of which the largest, *Blindia,* is the only one known from Southern Africa.

BLINDIA

Blindia *B.S.G.,* Bryol. Eur. 2: 17 (1846); Broth. in Natürl. PflFam. 10: 170 (1924); Sainsb., N. Zeal. Moss. 87 (1955); Smith, Moss Fl. Brit. Irel. 125 (1978). Type species: *B. acuta* (Hedw.) B.S.G.

Plants of medium size, yellowish green to brownish green, frequently dark brown to blackish below, glossy; generally saxicolous and semi-aquatic. *Stem* slender, simple or branched; central strand present. *Leaves* crowded, patent to falcate-secund; subulate above oblong, concave base. *Costa* narrow below, filling subula; in section cells not differentiated. *Laminal cells* rectangular to oblong-hexagonal, occasionally sinuolate; alar cells strongly differentiated, coloured.

Dioicous or autoicous. Perichaetial leaves occasionally distinct. *Seta* long or short, erect and flexuose to cygneous; capsule exserted or immersed, short-pyriform to subspherical; peristome teeth short-lanceolate, smooth, rarely absent; operculum obliquely beaked; calyptra cucullate; spores large, 20–32 μm.

A genus of 33 species, *Blindia* is most widely distributed in the Southern Hemisphere, especially in colder regions.

Blindia magellanica *Schimp. ex C. Müll.* in Bot. Ztg 20: 328 (1862); Broth. in Natürl. PflFam. 10: 171 (1924); Sainsb., N. Zeal. Moss. 87 (1955); Van Zanten in Van Zinderen Bakker et al. [eds], Marion and Prince Edward Islands 184 (1971). Type: South America, Tierre del Fuego, Insula Eremitae, *Hooker* s.n.

Plants of medium size, loosely caespitose, glossy, yellow-green above, brownish below; semi-aquatic. *Stems* 10–15 mm high, occasionally branched; in section subround, central strand very small, inner cortical cells in 4 rows, incrassate, outer cortical cells smaller, in 2 rows, stereids. *Leaves* crowded, weakly secund above, erect below wet or dry; lanceolate-subulate, 2,5–4,5 mm long, concave below; apex acute; margins entire, erect to incurved. *Costa* filling subula, superficial cells linear; in section subelliptical, flattened ventrally, cells weakly differentiated proximally, homogeneous in subula. *Upper laminal cells* incrassate, short- to long-rectangular, somewhat sinuolate, smooth or dorsal surface rough (obvious only in cross section); cells in subula short-rectangular; basal cells long-rectangular to oblong-hexagonal, sinuolate; alar cells strongly differentiated, quadrate, rectangular at margins, incrassate, reddish.

Sporophytes not known from Southern Africa. The generally smaller Marion Island plants have: perichaetial leaves undifferentiated; seta flexuose dry, cygneous wet, 4

mm long; capsule short-elliptical, 0,8 mm long, mouth broad; peristome teeth 16, short-triangular, smooth; operculum obliquely rostrate, 0,6 mm high; spores round, 20 μm. Fig. 26: 15–24.

New to Southern Africa, *B. magellanica* is known from southern South America, Australia, New Zealand and the subantarctic islands. In Southern Africa the species has only recently been collected on rock, at 3200 m, in northern Lesotho. Map 34.

Voucher: *Van Zanten* 76091012.

The species is most easily recognized by its strongly differentiated alar cells, the absence of specialized marginal leaf cells and by the cells of the costa in cross section being practically homogeneous. The plants and leaves of the Southern African specimen are larger than the Marion Island plants.

DICRANACEAE

Plants minute to large, gregarious or in dense cushions; terricolous or saxicolous. *Stems* erect, frequently tomentose below; central strand present or absent. *Leaves* appressed to spreading or squarrose, rarely falcate, secund; generally narrow, elongate, rarely ligulate or very short-oval, *or* consisting of modified multi-layered costa; bases occasionally clasping; margins plane or convolute, occasionally reflexed above, entire to dentate, sometimes bistratose; frequently bordered by several rows of narrow, elongate, hyaline cells. *Costa* strong or occasionally very weak, frequently very broad below, ending below apex to filling subula, or excurrent as long, denticulate awn; in section round to oblong, guide cells generally differentiated, ventral stereid band present or absent, ventral cells sometimes enlarged, dorsal stereid band generally strong or stereids in small groups separated by larger incrassate cells, dorsal surface smooth to rough, mammillose or with lamellae 1–6 cells long, or costa strongly modified, consisting of single layer of small, rhombic chlorocysts, surrounded by 2–8 layers of large, thin-walled leucocysts. *Upper laminal cells* quadrate to rectangular, occasionally elongate, incrassate, smooth or papillose, rarely mammillose or prorate, infrequently pitted; basal cells moderately differentiated, large, rectangular; alar cells occasionally differentiated, enlarged, reddish.

Perichaetia terminal or lateral through innovation; leaves rarely differentiated, occasionally base long-sheathing. *Seta* very short or elongate; capsule stegocarpous, peristomate or gymnostomous, or rarely cleistocarpous; urn short-elliptical to long-cylindrical, frequently ribbed, neck occasionally differentiated, long or short; peristome when present single, rudimentary to well developed, teeth generally cleft to middle, vertically striate or barred below, papillose above; operculum short- or long-rostrate; calyptra cucullate, base entire or rarely fringed; spores mostly small, infrequently highly ornate.

A large family comprising 64 genera, of which 14 are known from Southern Africa.

Key to Subfamilies of Dicranaceae

1 Alar cells conspicuous, enlarged, hyaline or coloured...Subfamily **Dicranoideae** (p. 126)
1 Alar cells not differentiated:
  2 Leaf cells strongly papillose, mammillose or prorate:
    3 Leaves squarrose above clasping base.....Subfamily **Dicranoideae** (p. 126)
    3 Leaves erect to spreading, not squarrose:
      4 Leaf cells prorate.....Subfamily **Trematodontoideae** (p. 106)
      4 Leaf cells papillose or mammillose.....Subfamily **Dicranoideae** (p. 126)
  2 Leaf cells essentially smooth:
    5 Leaves in section with small triangular or rhombic chlorocysts surrounded by enlarged, hyaline leucocysts.....Subfamily **Leucobryoideae** (p. 156)
    5 Leaf cells not differentiated into chlorocysts and leucocysts:
      6 Stems julaceous, leaves appressed when wet or dry:
        7 Leaf margins entire; costa weak, consisting of only a few undifferentiated, thin-walled cells..... Subfamily **Trematodontoideae** (p. 106)
        7 Leaf margins erose-dentate; costa stronger, consisting of 3 rows of stereids or substereids.....Subfamily **Dicranelloideae** (p. 118)

6 Leaves patent with flexuose tips when dry, spreading when wet:
8 Costa very broad, occupying ⅓ to ½ width of leaf base..... Subfamily **Dicranoideae** (p. 126)
8 Costa narrower, occupying less than ⅓ width of leaf base:
9 Costa excurrent as short, distinct awn; capsules pendent on flexuose seta ..... Subfamily **Dicranoideae** (p. 126)
9 Costa not excurrent as distinct awn, frequently percurrent or filling subula; capsule erect, seta weakly flexuose:
10 Capsules short-elliptical, without differentiated neck, generally ribbed when dry; leaves mostly abruptly subulate above oval or obovate base *or* stems elongate, leaves distant, ovate, acuminate to subulate..... Subfamily **Dicranelloideae** (p. 118)
10 Capsules elliptical to cylindrical with well defined neck, occasionally longer than urn; leaves acuminate to gradually subulate..... Subfamily **Trematodontoideae** (p. 106)

Subfamily TREMATODONTOIDEAE

Plants minute to medium, gregarious or in loose tufts; terricolous. *Stems* erect; central strand present. *Leaves* patent, ovate to oblong, acuminate to subulate *or* appressed, oval with broadly rounded apices; margins entire to serrate above. *Costa* strong or weak, narrow, flattened; in section with or without stereid or substereid bands. *Laminal cells* quadrate to rectangular, smooth or prorate; basal cells rectangular; alar cells not differentiated.

Perichaetia terminal; leaves erect, occasionally distinct from vegetative leaves. *Capsule* stegocarpic or cleistocarpic, immersed to exserted, with well developed neck; peristome absent, rudimentary or well developed; teeth with vertical bars below, perforated or cleft to below middle; operculum rostrate; calyptra cucullate or mitriform; spores large, papillose to spinose.

The genera treated in this subfamily would be included in the family Bruchiaceae, recently restored by Buck (1979).

Key to Genera of Subfamily Trematodontoideae

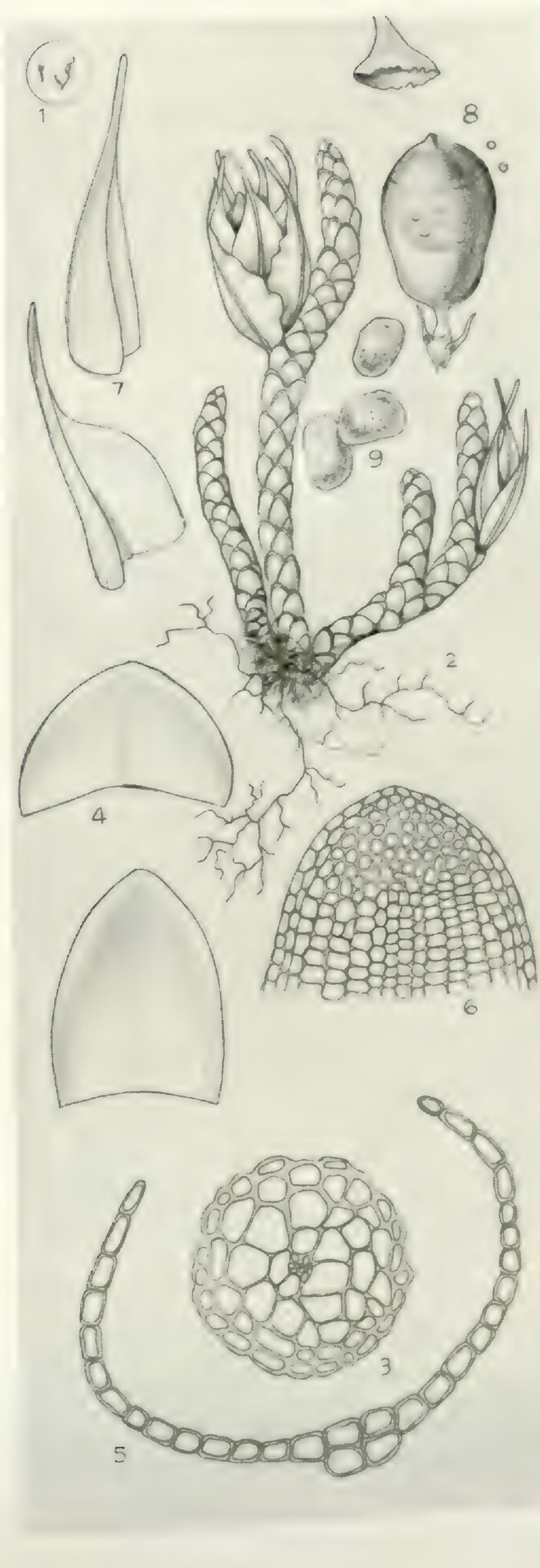
1 Plants small to medium; costa in section with guide cells and stereid or substereid bands; capsule exserted, neck long, narrow..... 3. **Trematodon**
1 Plants minute to small; costa in section without internal differentiation; capsule immersed, neck short, broad, with numerous large stomata:
2 Leaves erect, apex acuminate; capsule cleistocarpic.....1. **Bruchia**
2 Leaves appressed, apex round; capsule stegocarpic.....2. **Cladophascum**

1. BRUCHIA

Bruchia *Schwaegr.*, Spec. Musc. Suppl. 2: 91 (1824); Broth. in Natürl. PflFam. 10: 173 (1924); Sim, Bryo. S. Afr. 151 (1926). Type species: *B. vogesiaca* Schwaegr.

Plants very small to minute, gregarious or in small groups; terricolous. *Stems* very short; central strand present. *Leaves* patent; ovate-acuminate, generally bistratose above. *Costa* percurrent to short-excurrent; in section cells weakly differentiated. *Laminal cells* quadrate to rectangular, smooth.

FIG. 27.—**Cladophascum gymnomitrioides** (1–9): **1.** habit, ×1; **2.** habit, ×20; **3.** stem in cross section, ×150; **4.** leaves, ×50; **5.** leaf in cross section, ×435; **6.** leaf showing cells, ×85; **7.** perichaetial leaves, ×30; **8.** sporophyte with spores and calyptra, ×60; **9.** spores, ×260. **Bruchia brevipes** (10–20): **10.** habit, ×1; **11.** habit, ×20; **12.** stem in cross section, ×60; **13.** leaf, ×60; **14.** leaf in cross section, ×435; **15.** basal leaf cells at margin, ×170; **16.** leaf apex, ×170; **17.** perichaetial leaf, ×43; **18.** capsule with spores, ×20; **19.** calyptra, ×20; **20.** spore, ×426. (1–2 & 7–9, *Volk* 882; 3–6, *Sim* 8747; 10–20, *Magill & Schelpe* 4017).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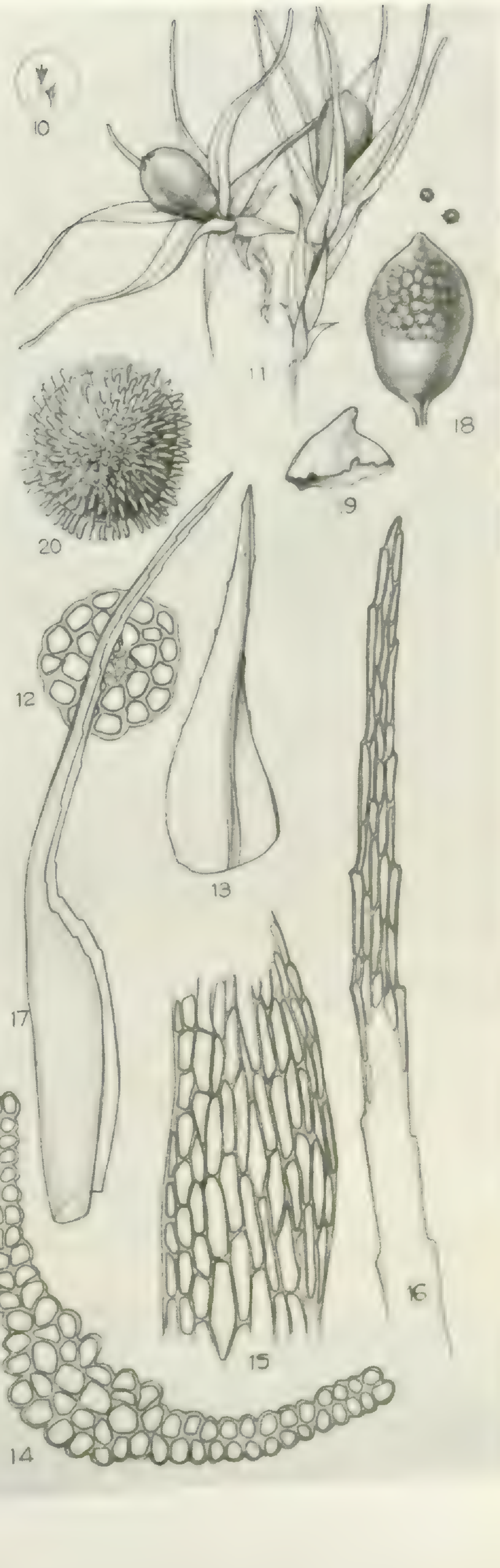
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Autoicous or dioicous. Perigonia gemmate, axillary or terminal on minute plants; perichaetia terminal; leaves oval-subulate to oblong-acuminate. *Capsule* cleistocarpic, immersed to emergent; urn pyriform or elliptical, neck well developed; calyptra mitriform; spores round to reniform, spinose or punctate.

The 24 species of *Bruchia* are scattered through the temperate regions of both hemispheres. By far the greatest number of species, namely 12, is known from North America, followed by southern South America with 5 species. Three species are known from Southern Africa.

1 Spores 40–45 μm; spinose.....1. *B. brevipes*
1 Spores 25–33 μm; not spinose:
2 Spores 30–33 μm; distal surface pitted, proximal surface with strong tetrad scar.....2. *B. foveolata*
2 Spores 25–30 μm; papillose to vermiculate, tetrad scar weak.....3. *B. eckloniana*

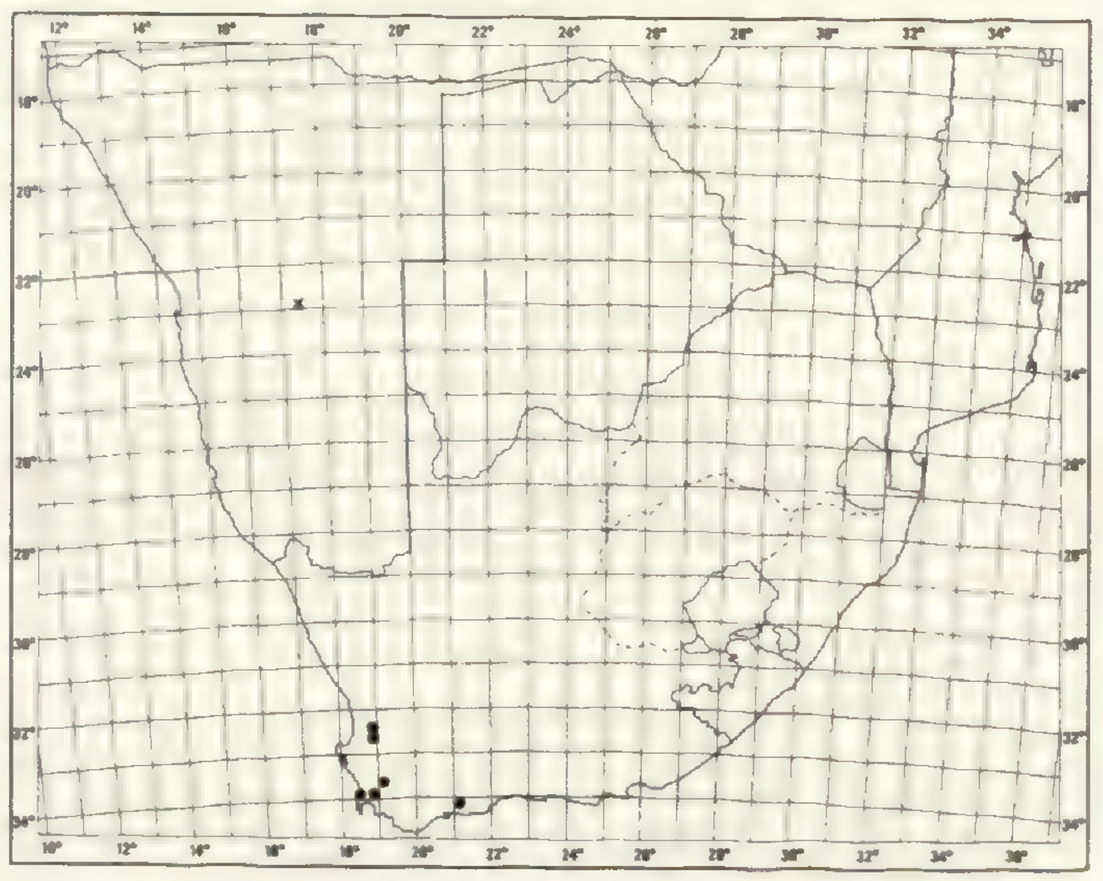
1. **Bruchia brevipes** *Harv. ex Hook.* in Hooker's, Icon. Pl. 3: 231 (1840); Broth. in Natürl. PflFam. 10: 173 (1924); Sim, Bryo. S. Afr. 152 (1926). Type: Cape, Newlands, *Harvey* s.n. (BM, holo.!; MANCH!).

Phascum elegans Hornsch. in Linnaea 15: 114 (1841). *Bruchia elegans* (Hornsch.) C. Müll. in Bot. Ztg 5: 99 (1847); Roth in Hedwigia 53: 92 (1913). Type: Cape, Table Mountain, *Ecklon* s.n. (H-BR!).

Plants minute, gregarious, light green; terricolous. *Stems* erect, to 0,5 mm high; in section with small central strand, cortical cells in ± 3 rows, uniform in size, incrassate, reddish. *Leaves* erect, bistratose above base; oval to ovate, acuminate to subulate in subperichaetial leaves, 1–2 mm long; margins plane, entire to serrulate by projecting cells. *Costa* excurrent, awn of upper leaves serrulate; ventral and dorsal superficial cells elongate, frequently prorate; in section guide cells 4, central, ventral cells in one layer, large, dorsal cells in 2 layers, large, incrassate. *Laminal cells* narrowly rectangular above shoulders; basal cells broader, rectangular to oblong-hexagonal.

Autoicous. Perigonia axillary, leaves oval-acuminate, 0,8 mm long. Perichaetial leaves oval-subulate, 2,5 mm long. *Seta* erect, 0,3–0,4 mm long; capsule cleistocarpic, pyriform, to 1 mm long, neck with numerous stomata, to 0,5 mm long; calyptra mitriform, covering upper urn; spores rounded to subreniform, spinose, 40–45 μm, yellowish. Fig. 27: 10–20.

Endemic to the fynbos biome of the southern and southwestern Cape, specimens of *B. brevipes* are rarely collected, perhaps because of their small size and ephemeral nature. The original collection was made in Cape Town; recent collections have been made in the mountains of the Clanwilliam area. Map 36.



MAP 36.— ● **Bruchia brevipes**
× **Bruchia foveolata**

Vouchers: *Magill & Schelpe* 4017; *Schelpe* 7710.

The plants grow on crusts of soil in association with *Pleuridium* and *Fissidens*. The small plants and cleistocarpic, pyriform capsules are distinctive and are diagnostic for the genus. Vegetatively the three Southern African species are very similar, although *B. brevipes* is slightly larger than the other two. The spores offer the only reliable characters for separating the three species.

2. **Bruchia foveolata** *Magill,* sp. nov., B. queenslandica *Stone habitu sculpturaque sporarum similis, sed statu dioico, marginibus foliarum reflexis irregulariter serratis et sporis majoribus differt.*

Type: South West Africa/Namibia, Windhoek, Farm Rietfontein, on soil, *Volk* 01160*a* (PRE, holo.; herb. Volk; MO).

Plants very small, scattered, yellow-green; terricolous. *Stems* 0,2–0,6 mm tall, simple; in section subround, central strand present, cortical cells in 3–4 rows, outer cells

weakly thickened. *Leaves* larger above, ±appressed dry, erect-spreading wet; lanceolate to linear-lanceolate, subulate, 0,5–1,5 mm long; margins reflexed, irregularly serrate by projecting cells, bistratose above. *Costa* short-excurrent; ventral and dorsal superficial cells rectangular, smooth; in section elliptical, guide cells not differentiated or 2 lateral cells larger, ventral and dorsal cells round, incrassate. *Upper laminal cells* rectangular to triangular, incrassate, smooth; basal cells weakly differentiated, rectangular, thin-walled, hyaline.

Dioicous. Male plants smaller, perigonia terminal. Perichaetia terminal; leaves larger, oval-subulate, 2,0–2,5 mm long. *Seta* 0,1–0,2 mm long, hyaline; capsule cleistocarpic, pyriform-rostrate, 1 mm long, yellowish,

FIG. 28.—**Bruchia foveolata** (1–12): **1.** habit, ×1; **2.** habit, ×26; **3.** stem in cross section, ×210; **4.** leaf, ×60; **5.** leaf in proximal cross section, ×435; **6.** leaf in distal cross section, ×435; **7.** basal leaf cells at margin, ×170; **8.** upper laminal cells, ×440; **9.** leaf apex, ×170; **10.** exothecial cells and stomata of capsule neck, ×200; **11.** calyptra, ×26; **12.** spores, ×640. **B. eckloniana** (13–22): **13.** habit, ×1; **14.** habit, ×40; **15.** leaves, ×80; **16.** leaf in distal cross section, ×640; **17.** leaf base, ×170; **18.** upper laminal cells, ×200; **19.** leaf apex, ×170; **20.** exothecial cells and stomata of capsule neck, ×200; **21.** calyptra, ×40; **22.** spore, ×640. (1–12, *Volk* 01160a; 13–22, *Ecklon* s.n.).

beak to 0,2 mm long, neck short, 0,3 mm long, stomata superficial (phaneropore); exothecial cells quadrate, thin-walled; calyptra mitriform, lobed below, smooth, 0,6 mm long, covering urn; spores subround to reniform, 30–33 μm, distal surface pitted, proximal surface with strong tetrad scar, bright light yellow. Fig. 28: 1–12.

This new species was collected on sandy soil in the Khomas Highland Savanna of central South West Africa/Namibia. Map 36.

Voucher: Type only.

In addition to the pitted spores with strong tetrad scars, *B. foveolata* differs from the other Southern African species by a large calyptra that completely covers the urn and the reflexed, irregularly serrate leaf margins.

3. **Bruchia eckloniana** *C. Müll.*, Syn. Musc. 1: 19 (1848); Broth. in Natürl. PflFam. 10: 173 (1924); Sim, Bryo. S. Afr. 152 (1926). Type: Cape, *Ecklon* s.n. (H-BR!).

Plants very small, scattered or in small groups, yellow-green; terricolous. *Stems* 0,2–0,4 mm high, simple; in section subround, central strand present, cortical cells in 3–4 rows. *Leaves* crowded, larger above, erect-spreading wet or dry; ovate-acuminate, 0,5–1,0 mm long, bistratose above; margins plane, entire. *Costa* percurrent to short-excurrent; ventral and dorsal superficial cells elongate, smooth; in section flattened, guide cells 2–4, weakly differentiated, ventral cells incrassate, in 1–2 rows, dorsal cells subquadrate, in 3 rows. *Upper laminal cells* quadrate to rectangular, incrassate, smooth; basal cells rectangular, incrassate, hyaline.

Dioicous. Perigonia terminal. Perichaetia terminal; leaves oblong-acuminate, 1,2–1,5 mm long. *Seta* 0,2 mm long, hyaline; capsule cleistocarpic, cylindrical-rostrate, 1 mm long, yellow, beak to 0,2 mm long, neck short, 0,2 mm long, stomata superficial (phaneropore); exothecial cells quadrate, thin-walled; calyptra mitrate, 0,4 mm long, covering upper capsule only; spores subround to reniform, 25–30 μm, vermiculate to papillose, red-brown. Fig. 28: 13–22.

The exact type locality is not given by Müller (1849) who cites only 'Prom. bon. spei: Ecklon'. Since additional collections have not been seen, the exact distribution of this species is not known. Map 37.

Voucher: Type only.

The spores of *B. eckloniana* are papillose or vermiculate when the papillae are united into irregular ridges. The small calyptra and the plane, entire leaf margins will help to identify the species.

2. CLADOPHASCUM

Cladophascum *Dix. ex Sim*, Bryo. S. Afr. 143 (1926). Type species: *C. gymnomitrioides* (Dix.) Dix. ex Sim.

Plants small, gregarious or in loose patches; terrestrial. *Stem* erect, sparsely branched; central strand present. *Leaves* appressed; oval, apex rounded. *Costa* weak, short; in section cells undifferentiated. *Laminal cells* quadrate to angular.

Perichaetia conspicuous; capsule immersed, stegocarpous; peristome absent; operculum conical; calyptra small, mitriform; spores large, papillose.

The monotypic genus *Cladophascum* is restricted to the central and western parts of Southern Africa and southern Zimbabwe.

Cladophascum gymnomitrioides (*Dix.*) *Dix. ex Sim*, Bryo. S. Afr. 143 (1926). Type: Zimbabwe, Matopos, *Sim* 8850 (BM, lecto.!, selected here; PRE!).

Aongstroemia gymnomitrioides Dix. in S. Afr. J. Sci. 18: 301 (1922); Broth. in Natürl. PflFam. 10: 179 (1924).

Plants small, in loose tufts, yellow-green; terricolous. *Stems* julaceous, erect, to 10 mm high, irregularly branched; in section round, central strand present, small, inner cortical cells large, subround, thin-walled, outer cortical cells quadrate to rectangular, in 1–2 rows, incrassate. *Leaves* imbricate, concave, semicircular to oval, 0,2–0,4 mm long; apex broadly obtuse to rounded; base clasping; margins erect, entire. *Costa* weak to above mid-leaf; in section consisting of 4 undifferentiated cells. *Upper laminal cells* smooth, quadrate to angular, strongly incrassate; upper marginal cells short-rectangular, thin-walled, hyaline, forming border 2–3 cells

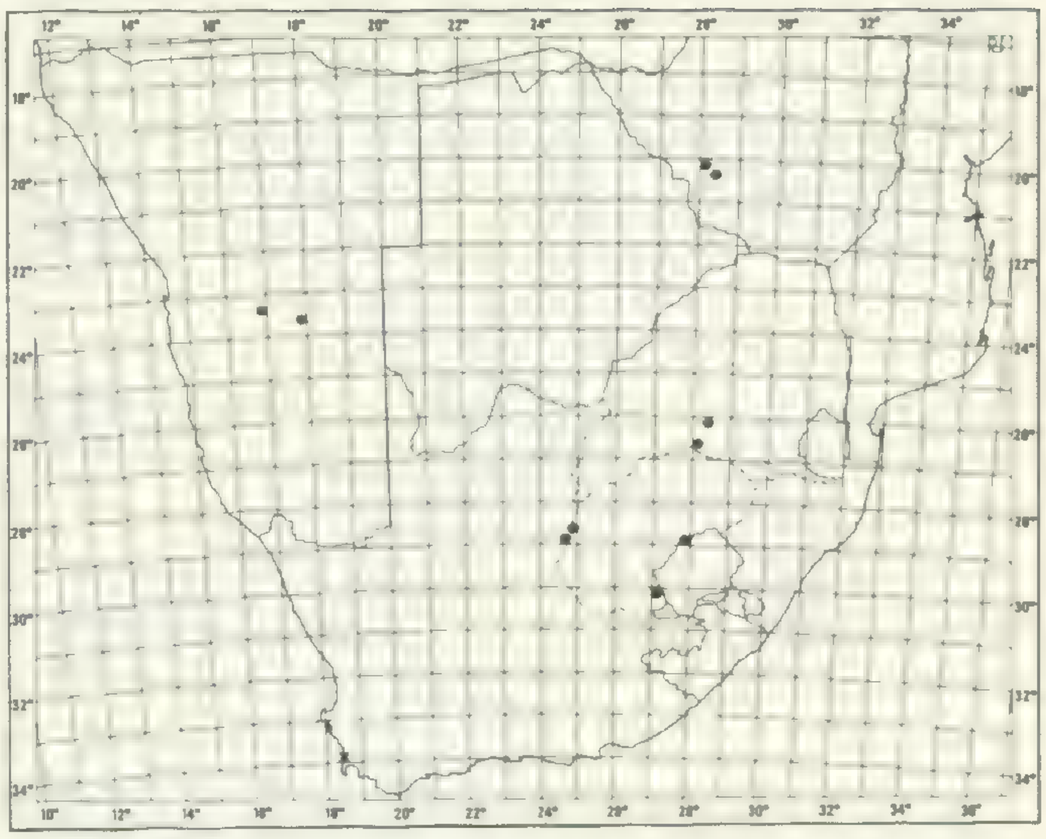
wide around apex; basal cells larger, quadrate to transversely rectangular, hyaline.

Synoicous. Perigonial leaves small, oval, obtuse. Perichaetia large, lateral through innovation; leaves broadly oval to oblong, abruptly cuspidate; costa strong above, excurrent, weak to absent in lower base. *Seta* very short, c. 0,1 mm long; capsule stegocarpous, pyriform, 0,6 mm long, neck short, 0,2 mm long, with numerous stomata; peristome absent; operculum conical, very short-beaked; calyptra mitriform, covering operculum; spores subreniform, 52–57 μm, lightly papillose. Fig. 27: 1–9.

These small plants are rarely collected. They grow on soil in grassland and savanna in southern Zimbabwe, southern Transvaal, Orange Free State, northern Cape and South West Africa/Namibia. Map 37.

Vouchers: *Sim* 9706, 9707; *Van Rooy* 485; *Volk* 882, 6094; *Wager* B155.

Sterile plants are characterized by the sparsely branched, julaceous stem. The large-leaved, lateral perichaetia of fertile plants are very distinctive. Gametophytically the plants are very distinct from any other genus in the family, however, the capsule morphology clearly indicates the correct placing of



MAP 37.— ● **Cladophascum gymnomitrioides**
× **Bruchia eckloniana**

Cladophascum in Trematodontoideae with *Bruchia* and *Trematodon*.

The lectotype (*Sim* 8850) was originally erroneously numbered 8450. The mistake was corrected in a letter from Sim to Dixon (PRE) and it was published as 8850. The error was, however, not corrected on the specimens.

3. TREMATODON

Trematodon *Michx.* in Fl. Bor. Am. 2: 289 (1803); Broth. in Natürl. PflFam. 10: 174 (1924); Grout, Moss Fl. N. Amer. 1: 37 (1936); Sim, Bryo. S. Afr. 152 (1926). Type species: *T. longicollis* Michx.

Plants very small to medium, gregarious or in loose tufts; terricolous or saxicolous. *Stems* erect, simple; central strand present. *Leaves* subulate above oblong to oval base; margins frequently bistratose. *Costa* generally subpercurrent, with or without ventral stereid band. *Leaf cells* rectangular, smooth or prorate.

Perichaetia terminal; leaves oval to oblong, subulate. *Capsule* exserted; urn cylindrical, neck as long as or longer than urn, frequently strumose; operculum long rostrate; calyptra cucullate.

Trematodon is a genus of c. 82 species found mostly in the Southern Hemisphere. The genus has been divided into two subgenera (cf. Brotherus, 1924), namely *Gymnotrematodon* with peristome absent or only a basal membrane present, and *Trematodon* with peristome well developed. Six species are known from Southern Africa, equally divided between the two subgenera.

Emphasis has been placed on sporophyte characters by most authors (Bartram, 1939; Gangulee, 1971), as is the case here. This should not cause problems, since specimens of *Trematodon*, in Southern Africa, are rarely collected without capsules.

1 Peristome absent or rudimentary (Subgenus *Gymnotrematodon*):
  2 Leaf cells prorate ..... 1. *T. pillansii*
  2 Leaf cells smooth:
    3 Upper leaves subulate; apex acute; cells of leaf margin narrowly rectangular, 7–10 μm wide; peristome rudimentary ..... 2. *T. intermedius*
    3 Upper leaves lingulate; apex obtuse; cells of leaf margin bulging rectangular, 15–18 μm wide; peristome absent ..... 3. *T. paradoxus*

1 Peristome well developed (Subgenus *Trematodon*):
4 Leaves lanceolate to ligulate, obtuse.....6. *T. mayottensis*
4 Leaves oblong to oval, abruptly subulate:
5 Capsule neck ± as long as urn; spores with distinct tetrad scar, 30–35 μm.....4. *T. divaricatus*
5 Capsule neck longer than urn; spores without distinct scar, 22–25 μm.....5. *T. longicollis*

1. **Trematodon pillansii** *Dix. ex Sim*, Bryo. S. Afr. 153 (1926). Type: Cape, Miller's Point, *Pillans* 4058 (BM, lecto.!, selected here; BOL!; PRE!).

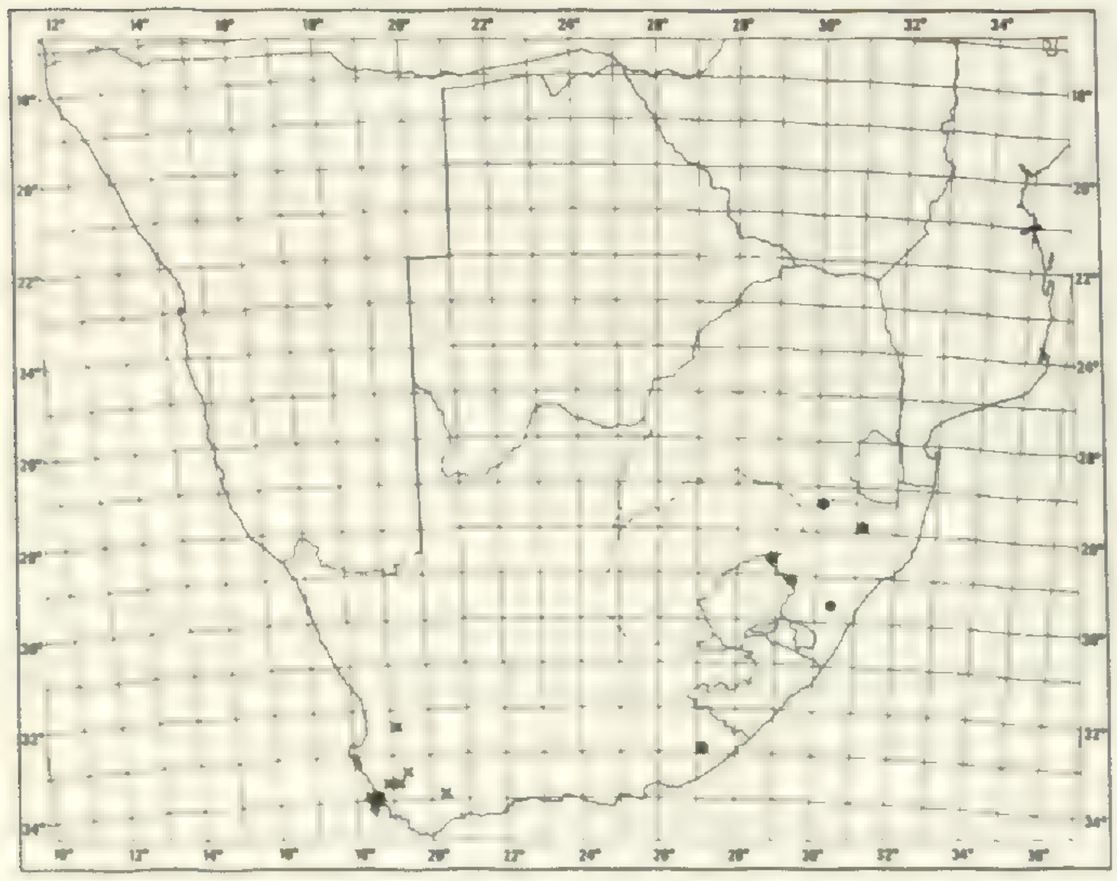
Plants very small, gregarious, yellowish green; saxicolous or terricolous. *Stems* to 1 mm high; in section central strand very small, cortical cells incrassate, slightly smaller toward margin, reddish. *Leaves* spreading wet and dry; oblong to oval, subulate, 1,0–1,5 mm long; apex obtuse; margins crenate, dentate at apex; lamina bistratose above. *Costa* ending below apex; in section guide cells 4, central, ventral cells in 1–2 layers, strongly incrassate, dorsal cells in 2–3 layers, substereids or strongly incrassate. *Laminal cells* rectangular, occasionally quadrate at shoulders, proximal and distal ends prorate; basal cells larger, rectangular, smooth.

Perichaetial leaves oval, abruptly ligulate, 2,5 mm long; base sheathing. *Seta* erect, 4–5 mm long, yellow; capsule erect, yellowish, urn 1,0–1,2 mm long, neck 1,5–2,0 mm long, without stroma, exothecial cells short, hexagonal; peristome absent; operculum rostrate, 0,5 mm high; calyptra covering upper urn; spores round, 70–75 μm, proximal face with tetrad ridge, distal face with C-shaped papillae. Fig. 29: 1–9.

Described from the Cape Peninsula, *T. pillansii* is endemic to the southwestern Cape. The species grows on shallow soil and bare rock in the fynbos biome. Map 38.

Vouchers: *Barnard* 50333; *Esterhuysen* 24363; *Magill & Schelpe* 4068; *Pillans* 4060; *Sim* 9282, 9297.

The small size of these plants, prorate leaf cells, absence of peristome and the large spores are diagnostic for this species. These characters also indicate that *T. pillansii* is not closely related to the other Southern African species.

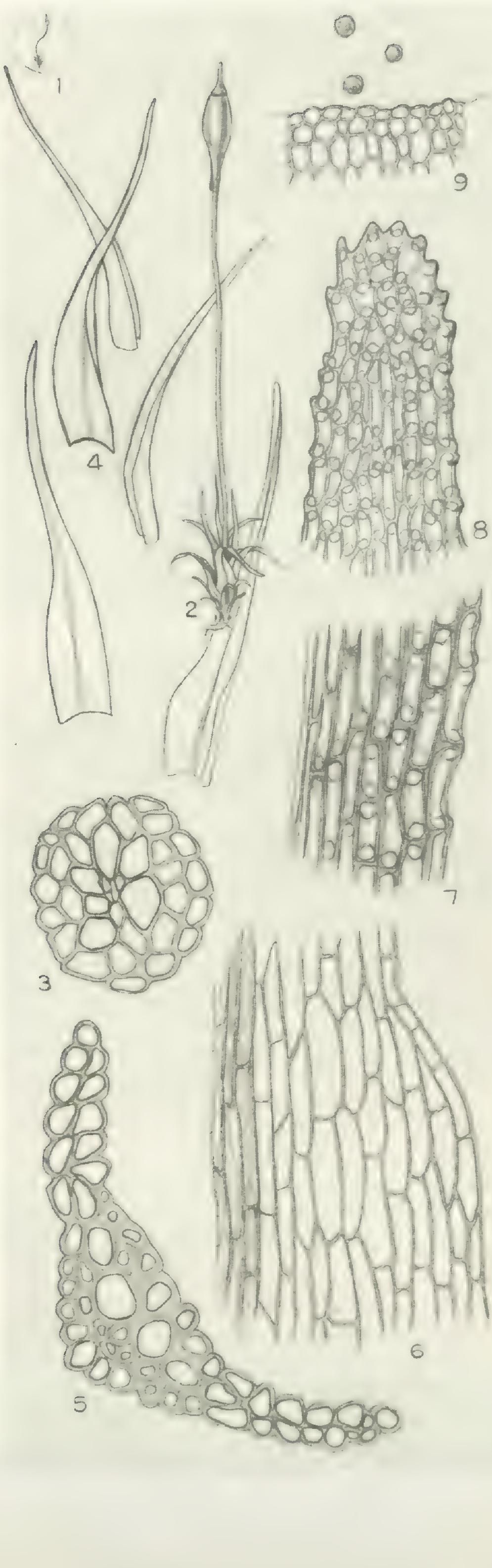


MAP 38.— ● **Trematodon paradoxus**
× **Trematodon pillansii**

2. **Trematodon intermedius** *Welw. & Duby* in Mém. Soc. Phys. Hist. nat. Genève 21: 226 (1870); Broth. in Natürl. PflFam. 10: 175 (1924); Dix. & Wag. in Trans. R. Soc. S. Afr. 18: 248 (1930). Type: Angola, Huilla, Lopollo River, *Welwitsch* 9 (G, holo.!).

Plants small, gregarious, green; terricolous. *Stems* 1–2 mm tall; in section central strand small, inner cortical cells lax, outer cortical cells small, incrassate, reddish. *Leaves* flexuose to erect wet or dry; oval to oblong, subulate, 1,5–3,0 mm long; apex acute, bluntly toothed; margins entire, bistratose above. *Costa* percurrent to short-excurrent; in section elliptical, guide cells 4, central, exposed laterally, ventral stereid

FIG. 29.—**Trematodon pillansii** (1–9): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×230; **4.** leaves, ×30; **5.** leaf in cross section, ×550; **6.** basal leaf cells, ×435; **7.** upper laminal cells at margin, ×435; **8.** leaf apex, ×435; **9.** part of capsule mouth and spores, ×35. **T. intermedius** (10–18): **10.** habit, ×1; **11.** habit, ×10; **12.** leaves, ×25; **13.** leaf in cross section, ×275; **14.** basal leaf cells at costa, ×200; **15.** upper laminal cells at margin, ×200; **16.** leaf apex, ×200; **17.** part of capsule mouth with rudimentary peristome and spores, ×35; **18.** operculum, ×10. **T. paradoxus** (19–27): **19.** habit, ×1; **20.** habit, ×10; **21.** stem in cross section, ×230; **22.** leaves, ×25; **23.** leaf in cross section, ×500; **24.** basal leaf cells at costa, ×400; **25.** upper laminal cells at margin, ×400; **26.** leaf apex, ×400; **27.** part of capsule mouth and spores, ×35. (1–9, *Magill* 4068; 10–11, *Sim* 8187; 12–18, *Kemp* 746; 19–27, *Sim* 7213).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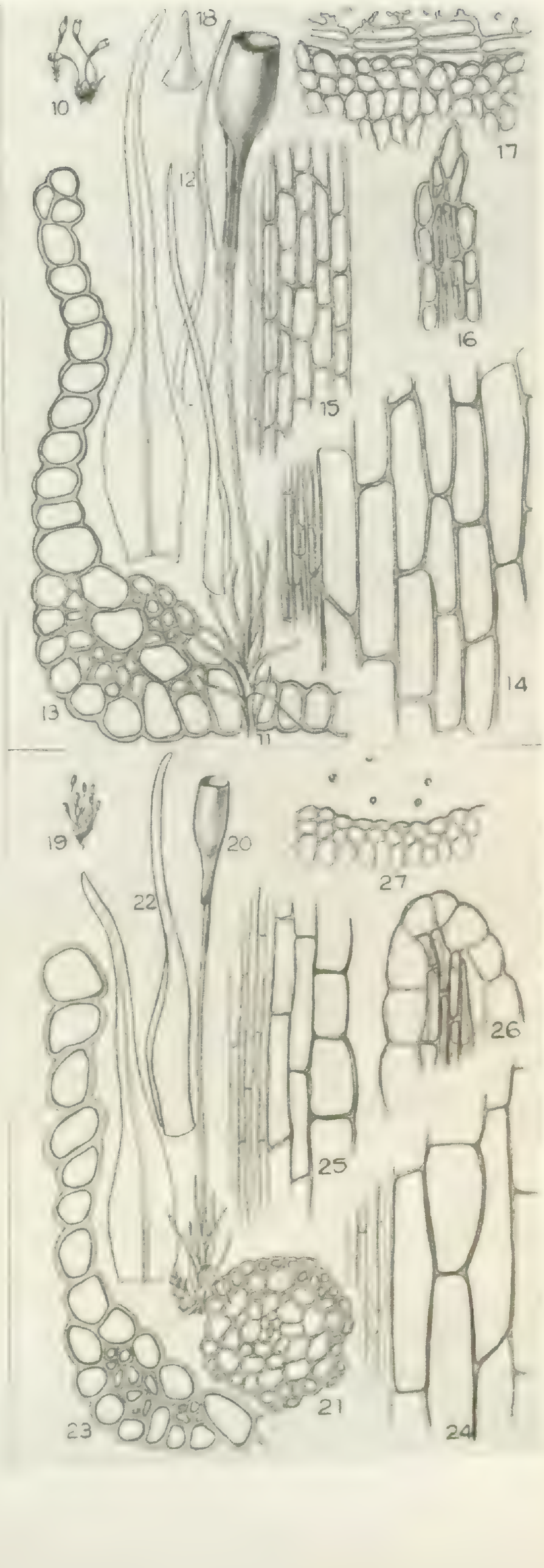
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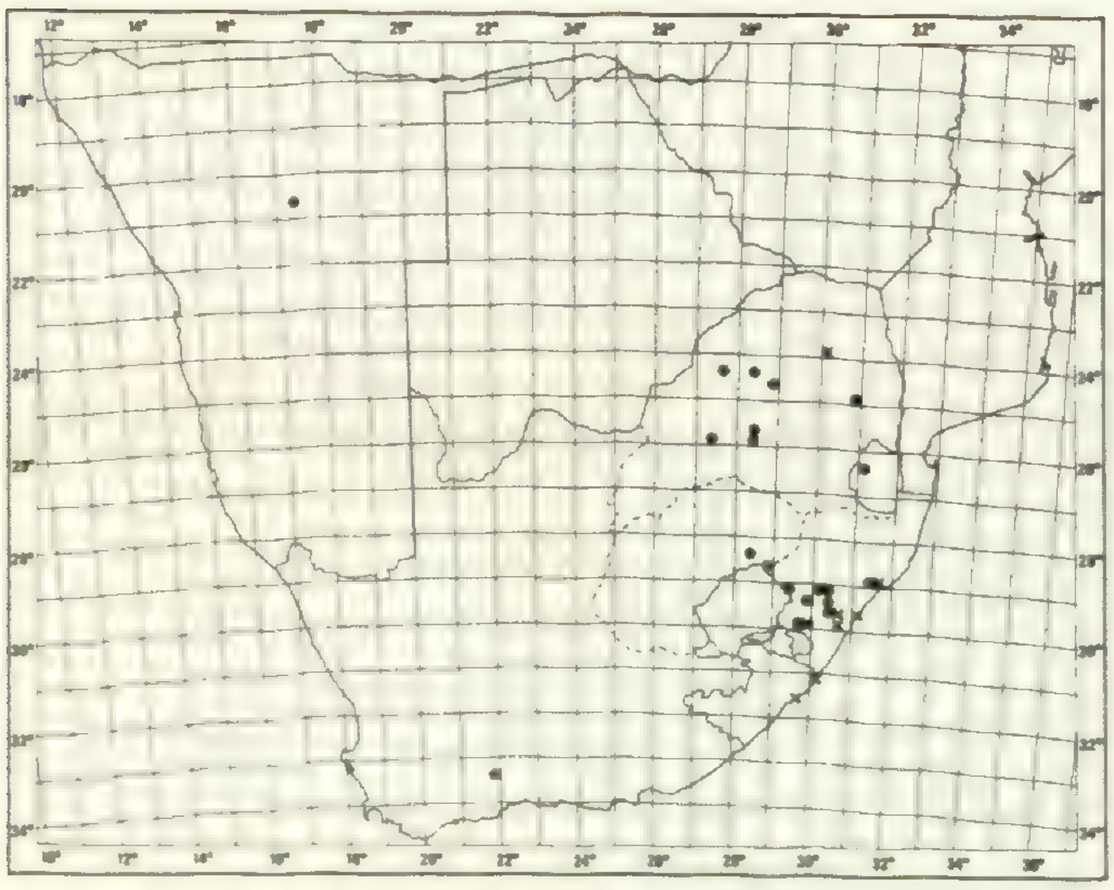
band small, of 6–8 cells in central group, ventral surface cells small, incrassate, only over stereid band, dorsal stereid band in 1–2 rows across costa, dorsal surface cells larger, completely covering stereid band. *Laminal cells* rectangular above shoulders; basal cells lax, rectangular to oblong-hexagonal.

Perichaetial leaves oblong-subulate, 2,0–2,5 mm long. *Seta* erect, 3–4 mm long, yellow; capsule erect, yellow, urn short-cylindrical, to 1 mm long, neck to 1,5 mm long, strumose; peristome rudimentary, consisting of short basal membrane, occasionally with short, irregular, papillose thickenings; operculum rostrate, to 1 mm long; calyptra cucullate, small, not completely covering urn; spores rounded, 25–28 μm, papillose. Fig. 29: 10–18.

Originally described from Angola, *T. intermedius* is also known from east Africa south into Zimbabwe, the central and eastern Transvaal, Swaziland, eastern Orange Free State, Natal, Zululand, southern Cape and northern South West Africa/Namibia. Map 39.



MAP 39.— ● **Trematodon intermedius**
× **Trematodon divaricatus**

Vouchers: *Cholnoky* 242; *Kemp* 746; *Rehmann* 439; *Sim* 8450: *Wager* 184; *Volk* 2225; *Welwitsch* 20.

Sim's (1926) treatment of *T. intermedius* as a synonym of *T. paradoxus* is incorrect. The leaves of the two species, especially the shape of the subula and upper leaf cells, are quite distinct, as noted by Brotherus (1924) and Dixon & Wager (1930). In addition, the peristome is completely absent in *T. paradoxus* but present, although rudimentary, in *T. intermedius*.

3. **Trematodon paradoxus** *Hornsch.* in Linnaea 15: 122 (1841); Broth. in Natürl. PflFam. 10: 176 (1924); Dix. & Wag. in Trans. R. Soc. S. Afr. 18: 248 (1930). Type: Cape, Table Mountain, *Ecklon* s.n. (BM!).

Plants very small, in scattered groups, green; terricolous. *Stems* 1–2 mm high; in section central strand small, inner cortical cells large, thin-walled, outer cortical cells in 2 rows, small, incrassate, red. *Leaves* erect, weakly flexuose dry, erect-spreading wet; oval to oblong, abruptly linear, 1,5–2,0 mm long; apex obtuse, occasionally acute; margins plane, entire, unistratose. *Costa* subpercurrent, in section guide cells 4, exposed ventrally, dorsal stereid band 1–2 cells thick, dorsal surface cells larger, weakly thickened, occasionally extending upward interrupting stereid band. *Laminal cells* bulging, rectangular above shoulders, in 1–3 rows on either side of costa at apex; marginal cells bulging; basal cell long-rectangular or oblong-hexagonal, lax.

Perichaetial leaves oblong-subulate, 2,0–2,5 mm long. *Seta* erect to flexuose dry, 2–3 mm long, yellow; capsule erect, yellow, urn 1 mm long, neck 0,8–1,0 mm long, strumose; peristome absent; operculum rostrate, 0,6–0,8 mm long; calyptra cucullate, covering operculum and capsule mouth; spores ± round, 30–35 μm, coarsely papillose. Fig. 29: 19–27.

Known from the Central African Republic, Zimbabwe and South Africa, *Trematodon paradoxus* was described from Table Mountain. Additional material from the southwestern Cape has not been seen. Recent specimens have been collected in the southeastern Transvaal, eastern Orange Free State, Zululand, Natal, and the eastern Cape. Map 38

Vouchers: *Cholnoky* 251; *Owen* 27; *Sim* 9725, 196; *Smook* 1098; *Tölken* 5739.

This species resembles *T. divaricatus* in many respects; however, *T. paradoxus* is generally smaller and lacks a peristome. The spores of this species also approach those of *T. divaricatus*, but they are not as highly ornamented and the tetrad scar is weak, when present.

4. **Trematodon divaricatus** *Bruch ex Krauss* in Flora, Jena 29: 133 (1846); Broth. in Natürl. PflFam. 10: 176 (1924). Type: Natal, Umgeni (Mgeni) River, *Krauss* s.n. (BM!).

Trematodon aequicollis Ren. & Card. in Bull. Soc. r. Bot. Belg. 41: 10 (1905); Broth. in Natürl. PflFam. 10: 176 (1924); Sim, Bryo. S. Afr. 156 (1926). Type: Zaire, Kisantu, *Gillet* s.n. (PC, holo.!).

Plants small, in loose tufts, green; terricolous. *Stems* 3–4 mm high, simple; in section central strand small, inner cortical cells large, thin-walled, outer cortical cells in 1–2 rows, smaller, incrassate, reddish. *Leaves* contorted dry, erect-flexuose wet; oblong to elliptical, abruptly subulate, 2,0–2,5 mm long; apex obtuse to acute; margins plane, bluntly toothed at apex. *Costa* broad below, ending below apex; in section flattened, guide cells exposed ventrally or with 2–3 small, ventral surface cells, dorsal stereid or substereid band 2 cells thick, dorsal surface cells smaller than guide cells, surface irregular, some cells bulging outward. *Upper laminal cells* short-rectangular to quadrate; marginal cells at shoulders and lower subula quadrate; basal cells large, lax, rectangular or oblong-hexagonal.

Perichaetial leaves similar to vegetative leaves, base broadly oval, clasping, 2,5–3,0 mm long. *Seta* erect, 10–13 mm long, yellow; capsule erect to nodding, brown, urn cylindrical, 2,5–3,0 mm long, neck to 1,5 mm long, weakly strumose; peristome reddish, teeth triangular, 0,4–0,5 mm high, perforated below, cleft into two filaments above, with vertical bars below, papillose apically, hyaline and papillose fringe between teeth forming ornate border on filaments and lower parts of teeth; operculum rostrate, to 1 mm high; calyptra cucullate, covering capsule; spores round, 30–35 μm, spinose, with distinct tetrad scar. Fig. 30: 1–11.

Trematodon divaricatus is known from eastern, western and Southern Africa. In the Flora area, it has been collected in the northeastern Transvaal but is more common from Zululand southwards through Natal to Port St Johns in the Transkei. Map 39.

Vouchers: *Van der Bijl* 27; *Lambert* 17; *Schelpe* 7522; *Sim* 9736; *Wager* 1474; *Wood* 7127.

This species is recognized by its wide leaf cells, short-necked capsule, peristome divided into filaments above and its strongly spinose spores with distinct tetrad scar. It can be separated from the very similar but smaller *T paradoxus* by longer leaves, broader costa and larger, peristomate capsule.

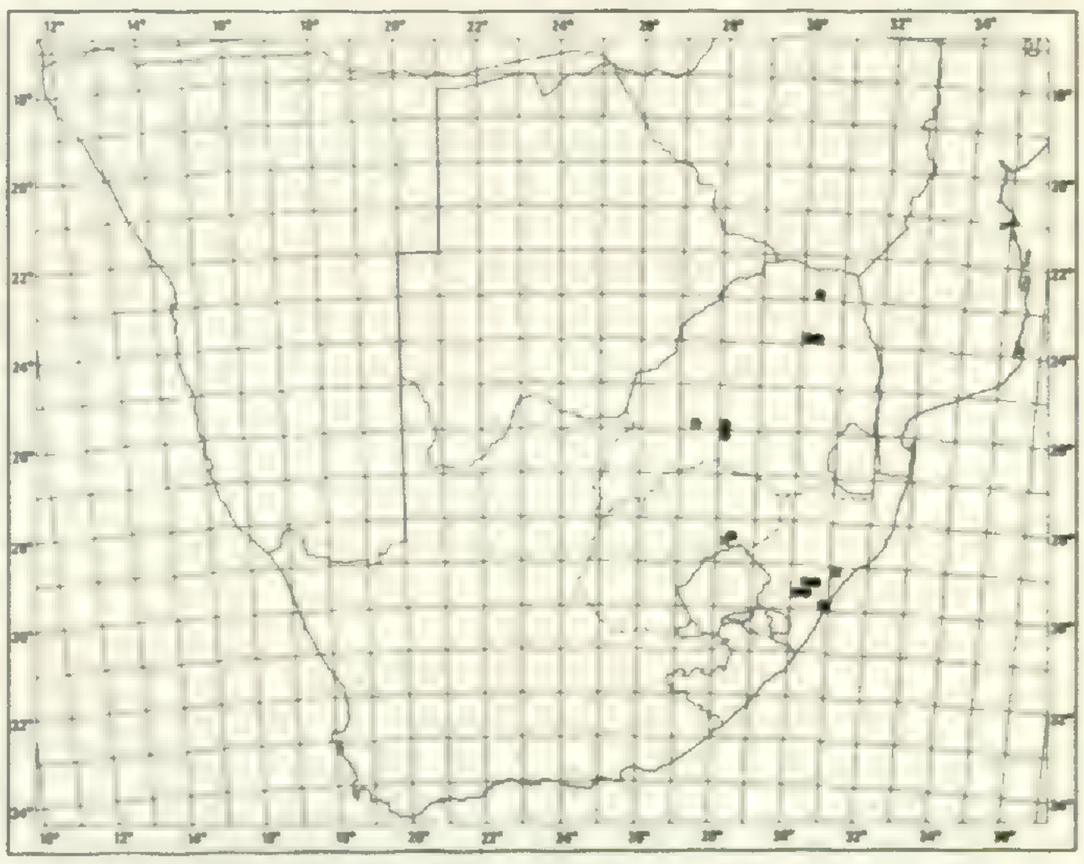
5. **Trematodon longicollis** *Michx.* in Fl. Bor. Am. 2: 289 (1803); Broth. in Natürl. PflFam. 10: 176 (1924); Bartram in Philipp. J. Sci. 68: 28 (1939); Gangulee, Moss. E. India 2: 231 (1971). Type: North America.

Trematodon pallidens C. Müll. in Linnaea 40: 242 (1876); Broth. in Natürl. PflFam. 10: 176 (1924); Sim, Bryo. S. Afr. 155 (1926). Type: Comoro Islands, *Hildebrandt* 1812 (BM!).

Trematodon flexifolius C. Müll. in Flora, Jena 69: 278 (1886); Broth. in Natürl. PflFam. 10: 176 (1924); Sim, Bryo. S. Afr. 155 (1926). Type: Sao Tome, *Henriquez* s.n.

Trematodon africanus Wag. & Dix. in Trans. R. Soc. S. Afr. 4: 4 (1914); Sim, Bryo. S. Afr. 154 (1926). Type: Transvaal, Tzaneen, *Wager* s.n., PRE-CH12159 (PRE, lecto.!, selected here; BM!).

Plants small to medium, gregarious or in loose tufts, green; terricolous. *Stems* 1–7 mm high; in section central strand large, cortical cells large, lax, becoming smaller with thicker walls toward margin. *Leaves* contorted above erect base dry, erect to spreading wet; oval to oblong, abruptly subulate, 2–4 mm long; apex bluntly acute; base sheathing; margin bistratose in subula, with a few projecting cells above, apex frequently toothed. *Costa* subpercurrent to percurrent; in section flattened, guide cells 6, ventral stereid band small, 3–4 cells in single central row, ventral surface cells smaller than guide cells, covering entire costal surface or restricted to area above ventral stereid band and exposing guide cells laterally, dorsal stereid band 1–3 cells thick, extending across costa, dorsal surface cells smaller than guide cells, occasionally some cells larger, extending upward



MAP 40.— ● **Trematodon longicollis**
× **Trematodon mayottensis**

interrupting stereid band. *Laminal cells* short-rectangular to quadrate above shoulders; basal cells large, lax, rectangular to oblong-hexagonal.

Perichaetial leaves oblong-subulate, 3–4 mm long. *Seta* 6–15 mm long, yellowish; capsule erect, yellow, urn cylindical, 1,2–1,6 mm long, neck 2,2–3,5 mm long, strumose; peristome reddish, teeth lanceolate, 340–360 μm high, perforated, without free filaments, vertically barred below, upper segments papillose, yellowish, fringe present between teeth, weak, papillose, hyaline; operculum long-beaked, 1,0–1,5 mm high; calyptra cucullate; spores round, 22–25 μm, bluntly papillose. Fig. 30: 21–29.

Cosmopolitan; in Southern Africa, this species has been collected in the northern, central and southern Transvaal, eastern Orange Free State and Natal. Map 40

Vouchers: *Bottomley* 1338; *Brenan* M2785; *Sim* 8559, 9730; *Wager* 92, 273, 1107.

The wider definition of this species employed by Bartram (1939) and Gangulee (1971) is adopted here. A capsule neck that is consistently twice as long as the urn, strongly perforated peristome teeth without free filaments, and papillose spores without obvious tetrad scar, separate *T. longicollis* from the other species. Although gametophytically similar to several other species, identification has not been a problem, as all collections examined have numerous sporophytes.

6. **Trematodon mayottensis** *Besch.* in Annls Sci. nat. Bot., sér. 7, 2: 84 (1885); Broth. in Natürl. PflFam. 10: 176 (1924); Sim, Bryo. S. Afr. 154 (1926). Type: Mayotte Island, *Marie* 1 (BM, holo.!).

Trematodon ligulatus Rehm. ex Roth in Hedwigia 53: 96 (1913). Type: Natal, Oakford, *Rehmann* 22 (PRE!).

Plants small, gregarious or in loose tufts, light green; terricolous. *Stems* (1–)2–3 mm high, simple; in section central strand large, cortical cells large, becoming incrassate toward margin. *Leaves* contorted dry, erect-spreading wet; lanceolate to ovate-ligulate, 1,0–1,6 mm long; apex obtuse to rounded; margins weakly reflexed, entire to crenulate above, bistratose; in section marginal cells rounded, smaller than rectangular laminal cells. *Costa* ending below apex to subpercurrent; in section flattened, cells not strongly differentiated, guide cells somewhat larger, ventral cells in single layer, thin-walled, dorsal substereid band 1–2 cells thick, cells variable in size and thickening occasionally only incrassate, dorsal surface cells similar to ventral cells. *Laminal cells* smooth, short-rectangular to quadrate, thin-walled; basal cells larger, rectangular, lax.

Perichaetial leaves not differentiated. *Seta* erect, 3 mm long, yellow-brown; capsule erect, yellow-brown, urn short-cylindrical, 1,8–2,0 mm long, neck 1 mm long, strumose at base; peristome reddish yellow, teeth triangular, to 240 μm high, irregularly perforated, with vertical bars below, apical segments free, papillose, hyaline; operculum long-beaked, 0,6 mm high; calyptra cucullate; spores subreniform, 22–27 μm, papillose. Fig. 30: 12–20.

In Southern Africa *T. mayottensis* is known from Oakford in Natal and Wolhuter Kop in the Orange Free State. The type is from Mayotte Island; additional specimens have been collected in Zimbabwe. Map 40.

Voucher: *Wager* 92.

Dixon & Wager (1930) disagreed with Sim's (1926) placing of *T. ligulatus* Rehm. ex Roth under *T. mayottensis*. Examination of the specimens involved, showed that the specimens of *Rehmann* 22, in South African herbaria, are *T. mayottensis*, while the specimen at BM is *T. longicollis* (Dixon in Sim corresp. in PRE as *T. africanus*). *Trematodon mayottensis* is separated from other species of *Trematodon* in Southern Africa, by its broad leaves and obtuse apices.

FIG. 30.—**Trematodon divaricatus** (1–11): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×135; **4.** leaves, ×35; **5.** leaf, ×50; **6.** leaf in cross section, ×435; **7.** basal leaf cells at costa, ×435; **8.** upper laminal cells at margin, ×240; **9.** leaf apex, ×435; **10.** part of capsule mouth with peristome teeth and spores, ×35; **11.** spores, ×300. **T. mayottensis** (12–20): **12.** habit, ×1; **13.** habit, ×10; **14.** stem in cross section, ×135; **15.** leaves, ×35; **16.** leaf in cross section, ×435; **17.** basal leaf cells at costa, ×220; **18.** upper laminal cells at costa, ×220; **19.** leaf apex, ×220; **20.** part of capsule mouth with peristome teeth and spores, ×35. **T. longicollis** (21–29): **21.** habit, ×1; **22.** habit, ×10; **23.** stem in cross section, ×135; **24.** leaves, ×35; **25.** leaf in cross section, ×435; **26.** basal leaf cells at costa, ×220; **27.** upper laminal cells at margin, ×220; **28.** leaf apex, ×220; **29.** part of capsule mouth with peristome teeth and spores, ×35. (1–11, *Van der Bijl* 27; 12–20, *Rehmann* 22; 21–29, *Wager* 1107*c*).

Subfamily DICRANELLOIDEAE

Plants small, caespitose, yellow-green; terricolous, or saxicolous. *Stems* erect, slender, occasionally julaceous; central strand present. *Leaves* appressed, spreading or squarrose; apex acuminate to subulate or rounded; margins plane, entire to erose-denticulate. *Costa* filling subula, percurrent or ending below apex, with dorsal stereid band. *Laminal cells* rectangular to rhomboidal, occasionally quadrate, smooth; alar cells not differentiated.

Dioicous or rarely monoicous. Perichaetia terminal, leaves not distinct or bases elongate. *Seta* erect; capsule short, elliptical to cylindrical, frequently ribbed dry; peristome present or absent, teeth cleft to middle, striate below or irregularly perforated, papillose throughout; operculum rostrate; calyptra cucullate.

Key to Genera of Subfamily Dicranelloideae

1 Stems julaceous; leaves appressed wet or dry.....1. **Aongstroemia**
1 Stems not julaceous; leaves flexuose or occasionally appressed dry, erect-spreading wet:
  2 Leaves abruptly subulate above broad base, 1,8–6,0 mm long.....2. **Dicranella**
  2 Leaves lanceolate, gradually acuminate, 1,0–1,8 mm long:
    3 Plants small; leaves closely set; stems smooth.....3. **Microdus**
    3 Plants long, slender; leaves distant; stems papillose.....2. **Dicranella**

1. AONGSTROEMIA

Aongstroemia *B.S.G.*, Bryol. Eur. 1: 171 (1846); Broth. in Natürl. PflFam. 10: 179 (1924); Sim, Bryo. S. Afr. 157 (1926). Type species: *A. longipes* (Somm.) B.S.G.

Plants small to medium, caespitose, yellow-green; terricolous. *Stems* slender, julaceous; central strand present. *Leaves* appressed wet or dry, oval to oblong; apices rounded or subulate; margins plane, entire to erose-denticulate. *Costa* ending below apex or filling subula; in section cells undifferentiated or guide cells exposed ventrally, dorsal stereid band well developed. *Laminal cells* elongate, incrassate.

Dioicous. Perichaetia terminal. *Setae* erect; capsules ovoid-cylindric; peristome present or absent; operculum rostrate.

The genus contains c. 15 species of temperate or alpine distribution. Two species occur in Southern Africa and are recognized by the small, slender, julaceous stems with closely appressed leaves wet or dry.

1 Leaves oval; apices rounded, apiculate; margins erose-denticulate; costa ending below apex....2. *A. julacea*
1 Leaves oblong; apices subulate; margins entire; costa extending into subula.....1. *A. filiformis*

1. **Aongstroemia filiformis** (*P. Beauv.*) *Wijk & Marg.* in Taxon 9: 50 (1960). Type: Madagascar.

Dicranum filiforme P. Beauv., Prodr. 53 (1805).

Weissia vulcanica Brid., Muscol. Recent. Suppl. 1: 124 (1806). *Aongstroemia vulcanica* (Brid.) C. Müll., Syn. Musc. 1: 427 (1848); Broth. in Natürl. PflFam. 10: 179 (1924); Sim, Bryo. S. Afr. 157 (1926). Type: Bourbon.

Aongstroemia transvaaliensis C. Müll. in Hedwigia 38: 89 (1899); Broth. in Natürl. PflFam. 10: 179 (1924). Type: Transvaal, Spitzkop, *Wilms* s.n. (G, holo.!).

Plants small to medium, loosely caespitose, yellow-green; terricolous. *Stems* julaceous, 10–20 mm high; in section subround, central strand of medium size, inner cortical cells in 2–3 rows, thin-walled, outer cortical cells in 2–4 rows, stereids. *Leaves* appressed with flexuose subulae wet or dry; oblong, 1,4–1,8 mm long; apex gradually subulate; base sheathing; margins plane, entire. *Costa* filling subula; in section guide cells 6–8, exposed ventrally, dorsal stereid band strong, in 3 rows, dorsal surface cells substereids,

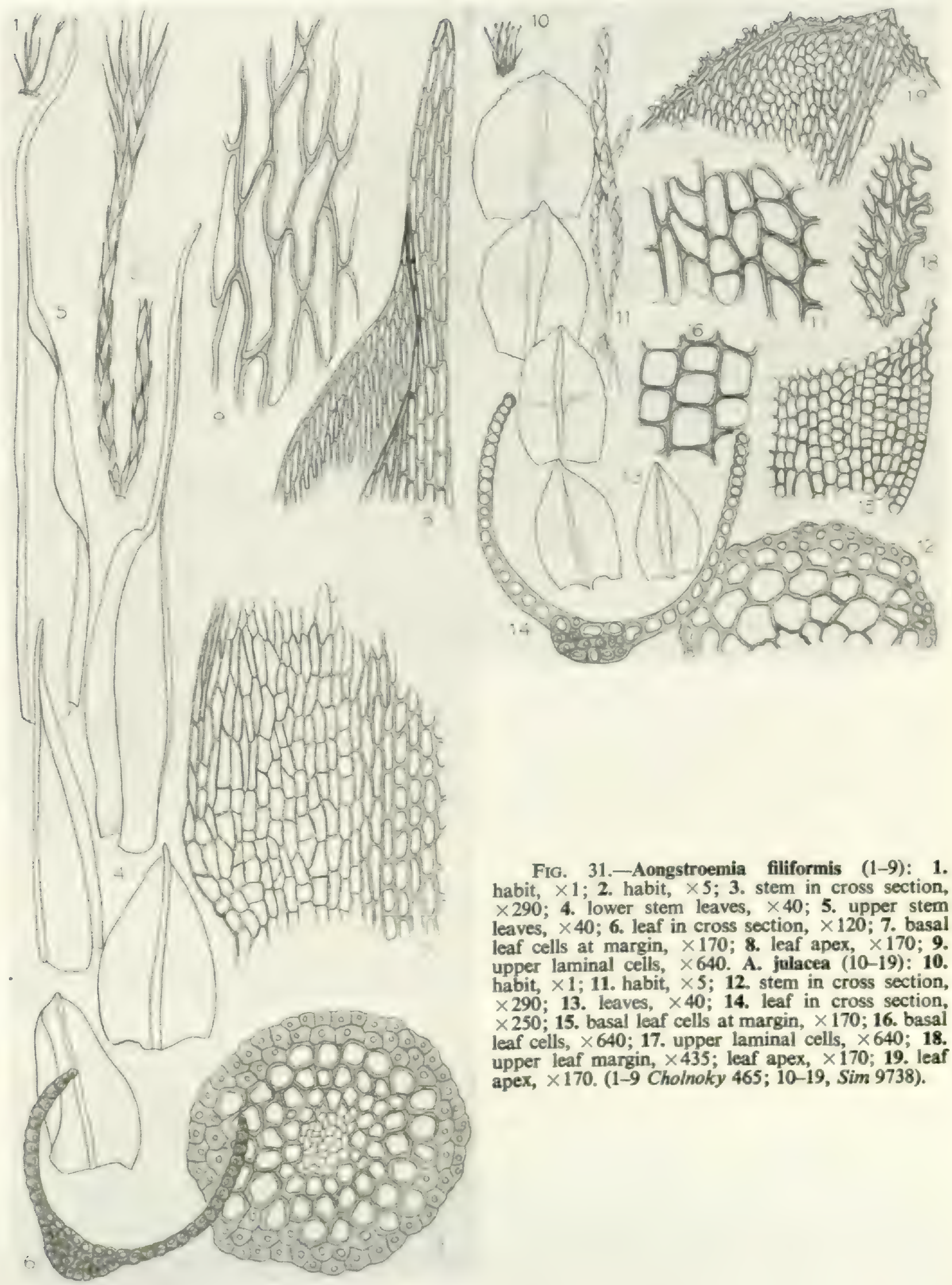


FIG. 31.—**Aongstroemia filiformis** (1–9): **1.** habit, ×1; **2.** habit, ×5; **3.** stem in cross section, ×290; **4.** lower stem leaves, ×40; **5.** upper stem leaves, ×40; **6.** leaf in cross section, ×120; **7.** basal leaf cells at margin, ×170; **8.** leaf apex, ×170; **9.** upper laminal cells, ×640. **A. julacea** (10–19): **10.** habit, ×1; **11.** habit, ×5; **12.** stem in cross section, ×290; **13.** leaves, ×40; **14.** leaf in cross section, ×250; **15.** basal leaf cells at margin, ×170; **16.** basal leaf cells, ×640; **17.** upper laminal cells, ×640; **18.** upper leaf margin, ×435; leaf apex, ×170; **19.** leaf apex, ×170. (1–9 *Cholnoky* 465; 10–19, *Sim* 9738).

with minute, blunt papillae covering dorsal surface of costa and lamina. *Upper laminal cells* rhomboidal to fusiform, weakly sinuolate, strongly incrassate, minutely papillose dorsally (visible in section only); basal cells rhomboidal to rectangular, weakly thickened.

Sporophyte not known in Southern Africa. Fig. 31: 1–9.

Found in East Africa, Madagascar and Reunion; in Southern Africa *A. filiformis* is rarely collected in forests of the eastern Transvaal and Natal. Map 41.

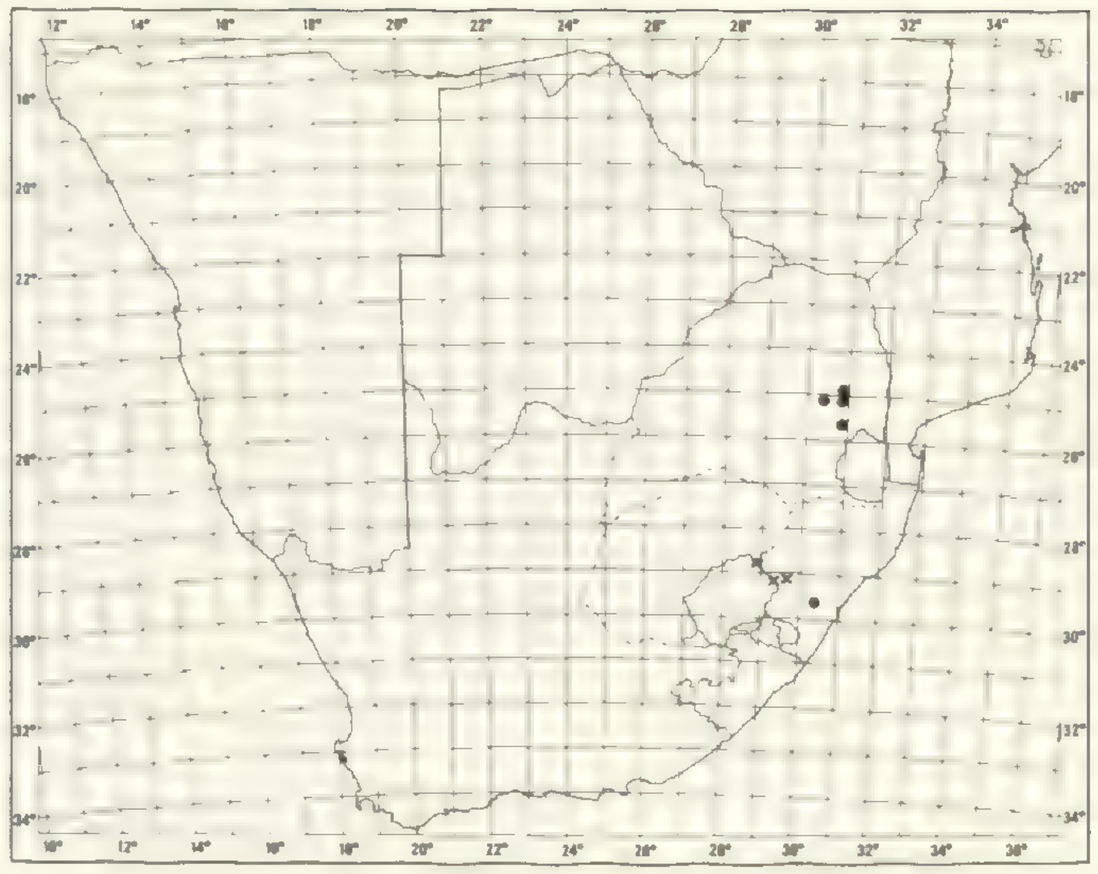
Voucher: *Cholnoky* 465.

The tall, slender plants and leaves with appressed bases and flexuose subulae are characteristic for this species.

2. **Aongstroemia julacea** (*Hook.*) *Mitt.* in J. Linn. Soc., Bot. 12: 27 (1869); Broth. in Natürl. PflFam. 10: 179 (1924); Sim, Bryo. S. Afr. 157 (1926). Type: Central America, Andes, *Humboldt & Bonpland* s.n.

Gymnostomum julaceum Hook., Musci Exot. 1: 42 (1918).

Plants small, caespitose, green to yellow-green; terricolous. *Stems* slender, julaceous, 5–10 mm high, simple; in section round, central strand of medium size, inner cortical cells large, in 3 rows, weakly thickened, outer cortical cells in 1–2 rows, stereids, reddish. *Leaves* appressed wet or dry; short-oval, 0,4–0,8 mm long; apex rounded-apiculate to acute; margins plane, erose-denticulate by projecting cell ends of adjoining marginal cells. *Costa* ending below apex; in section cells undifferentiated, in 3 rows, stereids and substereids. *Upper laminal cells* rectangular



MAP 41.— ● **Aongstroemia filiformis**
× **Aongstroemia julacea**

to rhombic, incrassate; basal cells slightly larger, quadrate, weakly thickened.

Sporophyte not known in Southern Africa. Fig. 31: 10–19.

Aongstroemia julacea is known from Central America, northern South America, Southern Africa, the East African Islands, India, northern Asia and Japan. In Southern Africa the species is only rarely collected in alpine grassland in the Drakensberg of Natal and Lesotho. Map 41.

Vouchers: *Edwards* PRE-CH4600; *Sim* 8686.

Although smaller, the julaceous stems of *A. julacea* macroscopically resemble *Anomobryum*. The leaf shape, costal development and anatomy, and leaf cell shape separate the genera. This species is recognized by its oval leaves with erose-denticulate margins and the costa ending below the apex.

2. DICRANELLA

Dicranella (*C. Müll.*) *Schimp.*, Coroll. 13 (1856); Broth. in Natürl. PflFam. 10: 181 (1924); Sim, Bryo. S. Afr. 158 (1926). Lectotype species: *D. grevilleana* (Brid.) Schimp., vide Grout, Moss Fl. N. Amer. 1:54 (1936).

Aongstroemia sect. *Dicranella* C. Müll., Syn. Musc. 1: 430 (1848).

Plants small, scattered or in dense tufts, yellowish green; terricolous or saxicolous. *Stems* simple or occasionally branched; central strand present. *Leaves* patent to squarrose; acuminate or abruptly subulate above oval or oblong to obovate, clasping base; margins plane, entire. *Costa* percurrent; ventral stereid band present or absent. *Laminal cells* quadrate to rectangular, incrassate, smooth; basal cells rectangular, thin-walled; alar cells not differentiated.

Dioicous or rarely monoicous. Perichaetia terminal, leaves similar to vegetative leaves, bases longer sheathing. *Seta* long, erect, straight, yellow to red-brown with age; capsule short-cylindrical, erect to curved, slightly ribbed dry; peristome erect, teeth cleft to middle, vertically striate below, red-yellow, papillose and hyaline above; operculum long-rostrate; calyptra cucullate; spores round, papillose.

The genus *Dicranella* contains approximately 60 species, found throughout temperate and tropical regions. The genus is infrequently collected in the eastern and southern parts of Southern Africa.

1 Leaves (2–) 4–6 mm long, subulate above oblong clasping base, lamina unistratose at mid-leaf..... 1. *D. subsubulata*

1 Leaves 0,8–2,2 mm long; lamina bistratose at mid-leaf:

2 Leaves patent, ovate to lanceolate, lamina irregularly bistratose above base..... 3. *D. rigida*

2 Leaves squarrose above oblong, clasping base, regularly bistratose above base..... 2. *D. symonsii*

1. **Dicranella subsubulata** (*C. Müll.*) *Jaeg.* in Verh. St Gall. naturw. Ges. 1870–71: 375 (1872); Broth. in Natürl. PflFam. 10: 182 (1924); Sim, Bryo. S. Afr. 159 (1926). Type: Cape, Gnadenthal, *Ecklon* s.n. (BM, holo.!).

Aongstroemia subsubulata Hampe ex C. Müll. in Bot. Ztg 16: 162 (1858).

Campylopus nanus C. Müll. in Bot. Ztg 5: 804 (1857). *Dicranum nanum* (C. Müll.) C. Müll., Syn. Musc. 1: 383 (1849). *Microcampylopus nanus* (C. Müll.) Broth. in Natürl. PflFam. 10: 183 (1924); Dixon in Trans. R. Soc S. Afr. 8: 185 (1920); Sim, Bryo. S. Afr. 180 (1926), non *Dicranella nana* Wint. in Hedwigia 55: 85 (1914). Type: Cape, Gnadenthal, *Drège* s.n. (BM!).

Aongstroemia borgeniana Hampe in Bot. Ztg 28: 33 (1870). *Dicranella borgeniana* (Hampe) Jaeg. ex Par., Ind. Bryol. 326 (1896); Broth. in Natürl. PflFam. 10: 182 (1924). Type: Natal, Mapumulo, *Borgen* s.n., 1867 (BM, holo.!; HBG!).

Aongstroemia abruptifolia C. Müll. in Hedwigia 38: 89 (1899). *Dicranella abruptifolia* (C. Müll.) Par., Ind. Bryol. 2: 6 (1903); Broth. in Natürl. PflFam. 1: 310 (1909).Type: Cape, Esternek, *Rehmann* 25 (BOL!; NH!; PRE!).

Microcampylopus pusillus C. Müll. in Hedwigia 38: 78 (1899); Dix. in Trans. R. Soc. S. Afr. 8: 185 (1920); Sim, Bryo. S. Afr. 180 (1926). Type: Cape, Montagu & Outeniqua Pass, *Breutel* s.n. (BM!).

Anisothecium natalense P. Varde in Revue bryol. lichen. 24: 29 (1955). Syntypes: Natal, Royal Natal National Park, *Cholnoky* 67, 11 (PC!).

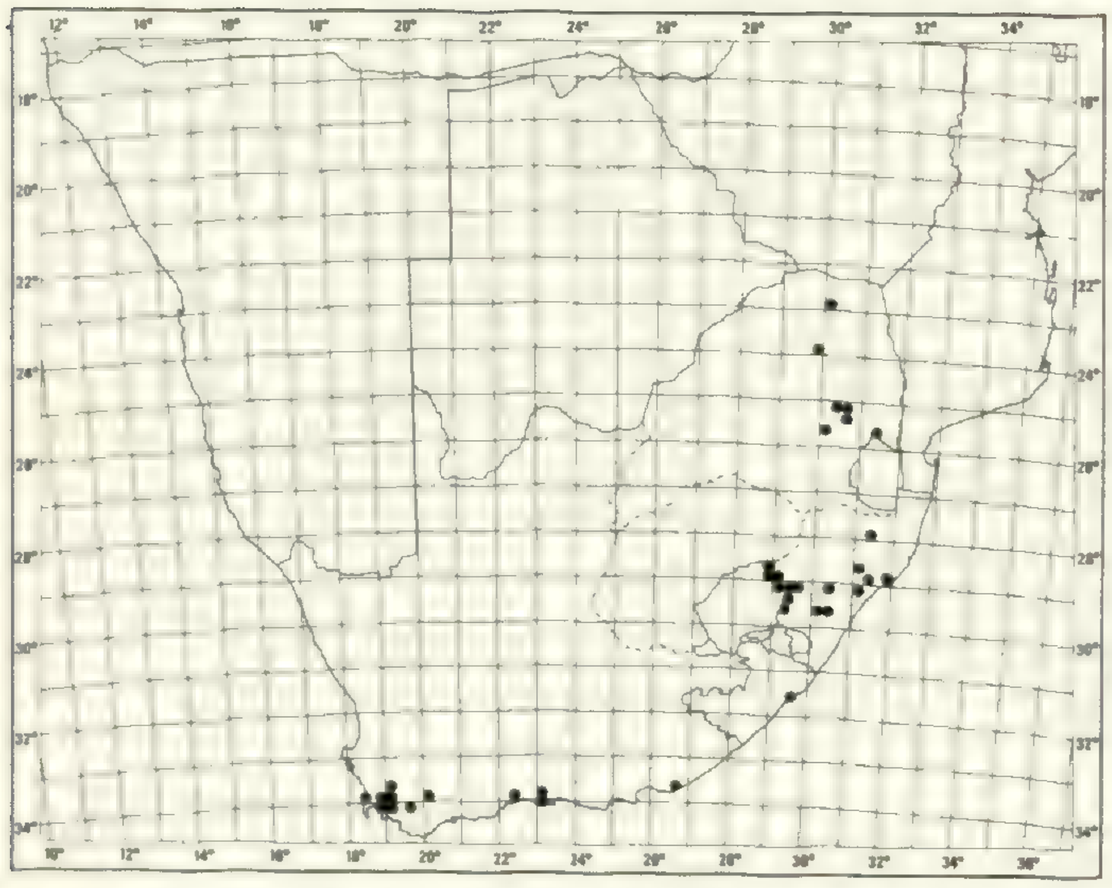
Plants small, loosely caespitose, green to yellow-green; terricolous. *Stems* 2–4(–8) mm long, simple; in section round, central strand present, inner cortical cells in 3–4 rows, thin-walled, outer cortical cells in 2 rows, smaller, incrassate. *Leaves* flexuose above base when dry, erect-spreading wet; abruptly subulate above broad, oblong to obovate or occasionally oval base, (2–)4–6 mm long; apex weakly toothed; base sheathing; margins plane, entire; in section lamina unistratose. *Costa* filling subula, dorsal and ventral superficial cells rectangular, smooth; in proximal section concave, guide cells 8, exposed laterally, ventral stereid band small, ventral surface cells small, incrassate, dorsal stereid band 4–5 cells thick, dorsal surface cells substereids, smooth; in distal section ventral stereid band small, ventral surface cells incrassate, dorsal stereid band 2–3 cells thick, occasionally some cells not stereids, dorsal surface cells incrassate, smooth. *Laminal cells* rectangular, incrassate, smooth; basal cells rectangular to rhomboidal, thin-walled.

Perichaetia terminal, leaves to 6 mm long, sheathing bases elongate. *Seta* erect, to 5 mm long, yellowish to red-yellow; capsules short-cylindrical, 1,5 mm long, weakly plicate dry, red-brown; exothecial cells rectangular, incrassate, quadrate to hexagonal at mouth; peristome erect, teeth triangular, 0,3 mm long, cleft to middle, vertically striate below, red-yellow, papillose and hyaline above; operculum long-rostrate, 1,1 mm long, cells not twisted; spores round, 30 μm, papillose, yellow-brown. Fig. 32: 1–12.

This species is presently known from eastern and Southern Africa. In the Flora area, *D. subsubulata* is infrequently collected in grassland and forest road cuttings or soil banks in the southwestern, southern and eastern Cape, Transkei, Natal, Lesotho, eastern Orange Free State, Zululand and the eastern and northern Transvaal. Map 42.

Vouchers: *Cholnoky* 390, 487, 904; *Magill* 4111.

The leaves of *D. subsubulata* are generally abruptly subulate above a broad, sheathing base. Leaves of smaller plants are occasionally more gradually constricted to the subula and have oval, rather than the typical oblong to obovate bases. The smooth, erect to flexuose subula will help to distinguish this species from *D. symonsii*.



MAP 42.— ● **Dicranella subsubulata**

2. **Dicranella symonsii** *Dix.* in Trans. R. Soc. S. Afr. 8: 183 (1920); Sim, Bryo. S. Afr. 160 (1926). Type: Natal, Giant's Castle, *Symons* sub *Sim* 8665 (PRE!).

Anisothecium symonsii (Dix.) Broth. in Natürl. PflFam. 10: 177 (1924).

Plants slender, forming cushions, green to yellow-green; saxicolous. *Stems* 20–40 mm high, infrequently branched, with dense reddish tomentum below; in section subround, central strand present, inner cortical cells in 3–4 rows, large, thin-walled, outer row smaller, incrassate. *Leaves* squarrose above clasping base wet or dry, flexuose above when dry; abruptly long-acuminate above oblong or obovate, clasping base, 1,8–2,2 mm long; apex weakly toothed; base sheathing stem; margins plane, entire; in section lamina bistratose, ventral cells larger. *Costa* not well defined, percurrent, to ⅓ width of leaf base, ventral superficial cells long-rectangular, smooth, dorsal superficial cells rectangular, mammillose; in distal section guide cells 6, large, ventral stereid band weak, in single layer, ventral surface cells small, rounded, incrassate, smooth, dorsal stereid band weak, in single layer or small groups separated by guide cells, dorsal surface cells vertically elongate, projecting dorsally. *Laminal cells* rectangular to short-rectangular, slightly thickened, papillose with low, weak papillae at both ends of cells in acumen; basal cells moderately differentiated, rectangular, somewhat larger, weakly thickened.

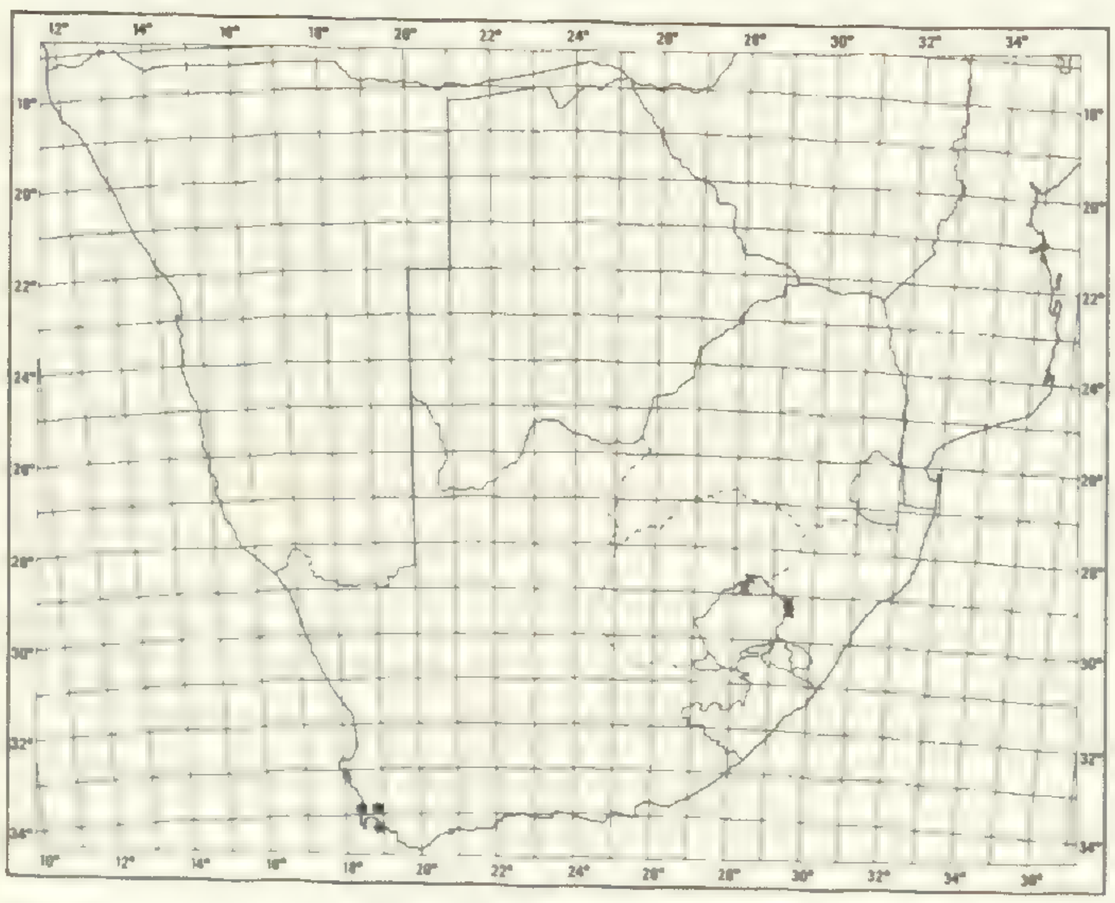
Sporophyte unknown. Fig. 32: 13–20.

Endemic to Southern Africa, *D. symonsii* is rarely collected on rock in the montane grasslands of the Drakensberg in Lesotho, Orange Free State and Natal. Map 43.

Voucher: *Esterhuysen* 20213.

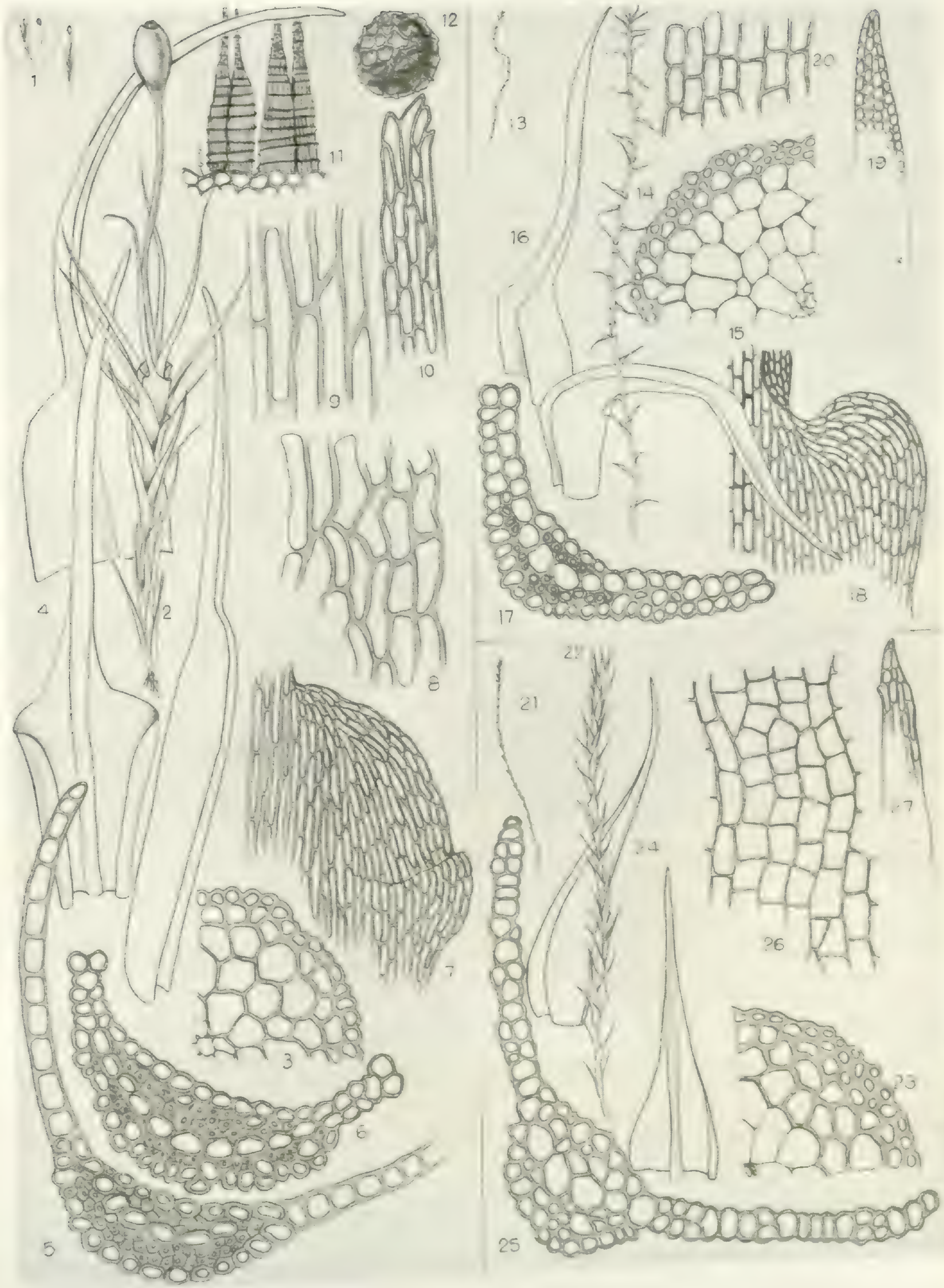
The long stems, sheathing leaf bases and squarrose, papillose acumens separate *D. symonsii* from the other species. The plants could perhaps be mistaken for a species of *Bartramia*, especially in view of the weak papillae at both ends of the cells in the acumen (prorate). The size of the plants, habit and anatomy seem to indicate the correct placing of these specimens in *Dicranella*, although sporophytes are needed before a final assessment can be made.

3. **Dicranella rigida** *Dix. ex Sim*, Bryo. S. Afr. 160 (1926). Type: Cape, Paarl, *Sim* 9633 (BM, holo.!; PRE!).



MAP 43.— ● **Dicranella rigida**
× **Dicranella symonsii**

FIG. 32.—**Dicranella subsubulata** (1–12): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×260; **4.** leaves, ×40; **5.** leaf in proximal cross section, ×435; **6.** leaf in distal cross section, ×435; **7.** cells at leaf shoulder, ×170; **8.** laminal cells at shoulder, ×640; **9.** upper laminal cells, ×640; **10.** leaf apex, ×170; **11.** part of capsule mouth with peristome teeth, ×120; **12.** spore, ×550. **D. symonsii** (13–20): **13.** habit, ×1; **14.** habit, ×5; **15.** stem in cross section, ×260; **16.** leaves, ×40; **17.** leaf in distal cross section, ×435; **18.** cells at leaf shoulder, ×170; **19.** leaf apex, ×170; **20.** upper laminal cells, ×640. **D. rigida** (21–27): **21.** habit, ×1; **22.** habit, ×5; **23.** stem in cross section, ×260; **24.** leaves, ×40; **25.** leaf in median cross section, ×435; **26.** upper laminal cells, ×640; **27.** leaf apex, ×170. (1–12, *Cholnoky* 962; 13–20, *Sim* 866; 21–27, *Sim* 9633).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Plants slender, forming loose mats, green to yellow-green; terricolous. *Stems* 10–30 mm long, ascending, rarely branched, papillose; in section round, central strand small, inner cortical cells in 3–4 rows, large, outer cortical cells in 2 rows, small, incrassate, cells of outer row with a single sharp papilla. *Leaves* distant, erect-spreading to flexuose dry, erect-spreading wet; ovate to lanceolate or triangular, short-acuminate to subulate, 0,8–1,8 mm long; base not sheathing; margins plane, entire; in section lamina bistratose in patches between costa and margin, cells of similar size, dorsal cells weakly bulging. *Costa* percurrent, ventral superficial cells long-rectangular, smooth, dorsal superficial cells rectangular, rough; in section guide cells 6, ventral cells in 2 rows, incrassate, dorsal cells in 2–3 rows, incrassate, dorsal surface cells slightly elongate vertically, bulging. *Laminal cells* quadrate, rectangular or triangular, thin-walled, smooth or mammillose, 3–4 rows of cells at insertion slightly larger, rectangular to rhomboidal.

Sporophyte unknown. Fig. 32: 21–27.

Endemic to Southern Africa, *D. rigida* is rarely collected in the fynbos biome of the southwestern Cape. Map 43.

Vouchers: *Brenan* M2763; *Garside* 6461, 6622.

The long, slender stems and small, distant leaves give the plants an etiolated appearance. The leaves vary in size and shape in the few specimens seen.

The habit, papillose stem, rectangular, thin-walled leaf cells and leaf anatomy give the plants a distinctive appearance, but *D. rigida* remains a troublesome species to identify.

3. MICRODUS

Microdus *Schimp. ex Besch.* in Mém. Soc. Sci. nat. Cherbourg 16: 161 (1872); Broth. in Natürl. PflFam. 10: 181 (1924); Gangulee, Moss. E. India 247 (1971). Type species: not designated.

Plants small, tufted; terricolous. *Stems* with central strand. *Leaves* appressed to erect-spreading, narrow; lanceolate to elliptical, acuminate; margins plane, entire. *Costa* percurrent, with dorsal stereid band. *Upper laminal cells* quadrate to rhomboidal, weakly thickened; alar cells not differentiated.

Dioicous. Perichaetia terminal, leaves not distinct. *Seta* erect; capsule short, oval to cylindrical; peristome teeth somewhat irregular, cleft or perforated, papillose; operculum long-rostrate; spores small, papillose.

A genus of c. 60 species found primarily in tropical regions throughout the world. The genus is rare in temperate regions, as is the case in Southern Africa.

Microdus minutus (*Hampe*) *Besch.* in Annls Sci. nat. Bot., sér. 6, 9: 305 (1880); Broth. in Natürl. PflFam. 10: 181 (1924). Type: Madagascar, *Borgen* sub 22 (BM, holo.!).

Aongstroemia minuta Hampe in Linnaea 38: 209 (1874). *Dicranella minuta* (Hampe) Jaeg. in Verh. St Gall. naturw. Ges. 1877–78: 375 (1880); Sim, Bryo. S. Afr. 158 (1926).

Plants small, loosely caespitose, green to yellow-green; terricolous. *Stems* 2–4 mm high, rarely branched; in section round, central strand small, inner cortical cells in 2–4 rows, thin-walled, outer row weakly thickened, reddish. *Leaves* weakly appressed dry, erect-spreading wet; lanceolate or oblong to elliptical, acuminate, 1,0–1,4 mm long; margins plane, entire; in section lamina infrequently with small, bistratose patches. *Costa* percurrent; in section crescent-shaped, guide cells 6, ventral cells absent or 1–2 large, thin-walled cells over central guide cells, dorsal stereid or substereid band 1–2 cells thick, dorsal surface cells incrassate, weakly bulging, occasionally all cells except on dorsal surface undifferentiated, strongly incrassate. *Upper laminal cells* quadrate, rectangular or rhomboidal, weakly thickened, smooth; basal cells moderately differentiated, rectangular, thin-walled or slightly thickened.

Perichaetia terminal; leaves slightly larger. *Seta* erect, to 4 mm long, red-brown; capsules elliptical, 0,6–0,8 mm long, constricted below mouth when dry, red-brown to yellow-brown, exothecial cells rectangular,

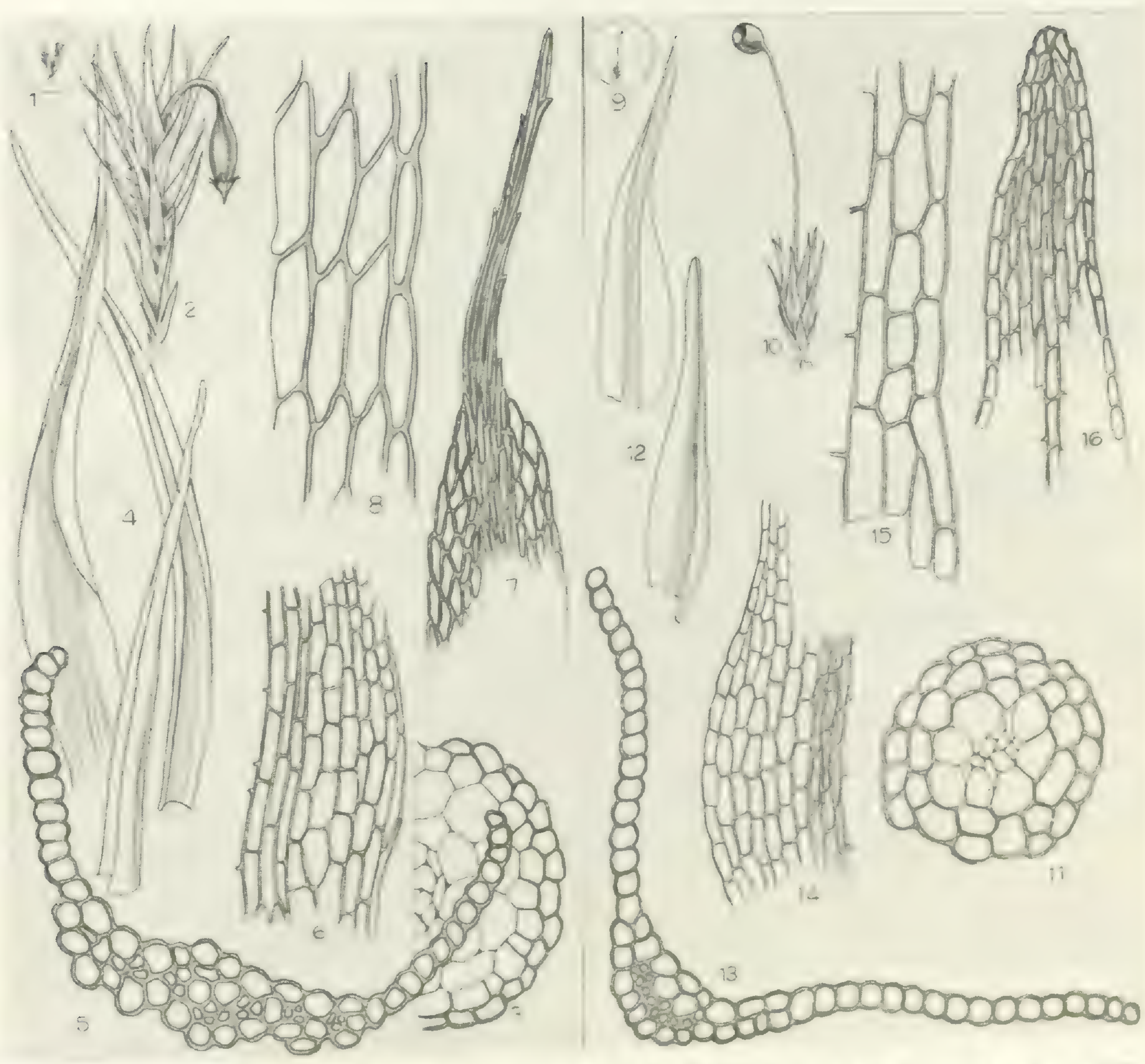
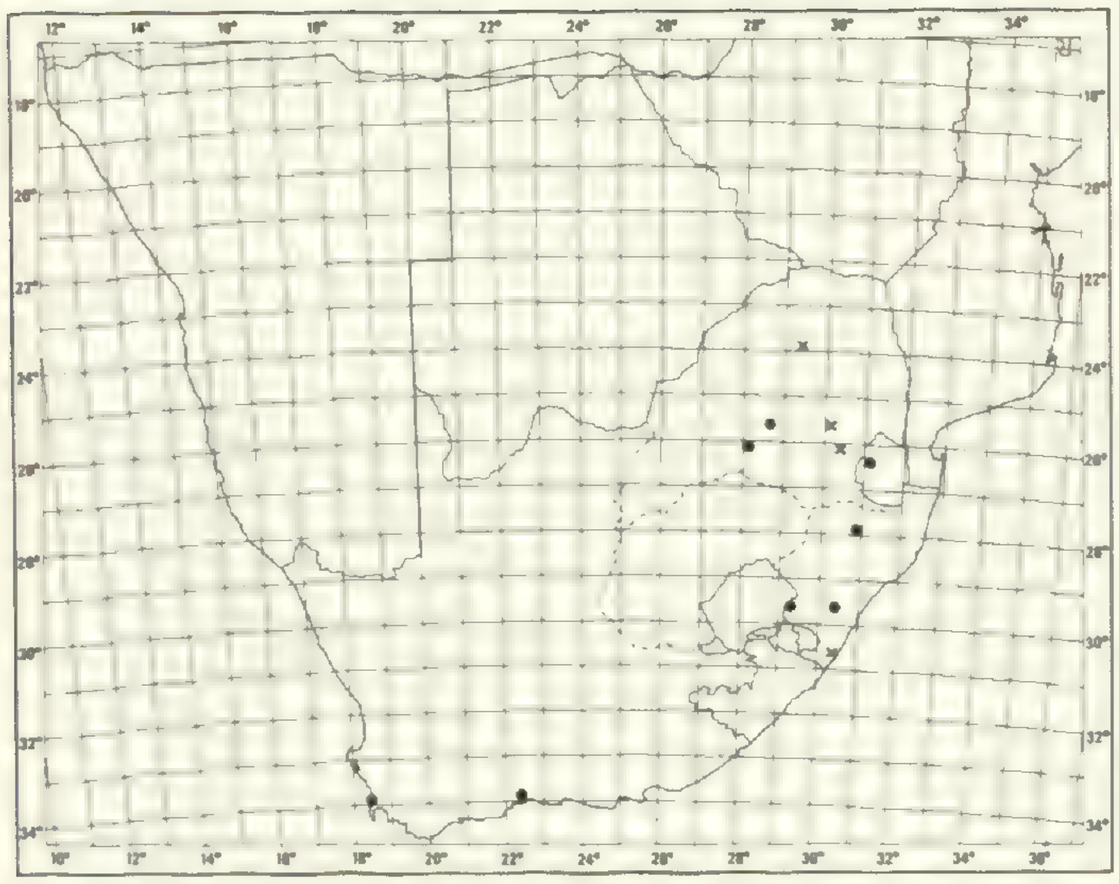


FIG. 33.—**Microcampylopus perpusillus** (1–8): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×350; **4.** leaves, ×40; **5.** leaf in cross section, ×170; **6.** basal leaf cells, ×170; **7.** leaf apex, ×170; **8.** upper laminal cells at margin, ×640. **Microdus minutus** (9–16): **9.** habit, ×1; **10.** habit, ×10; **11.** stem in cross section, ×350; **12.** leaves, ×40; **13.** leaf in cross section, ×435; **14.** basal leaf cells, ×170; **15.** upper laminal cells at margin, ×640; **16.** leaf apex, ×170. (1–8, *Sim* 8789; 9–16, *Magill* 3421).



MAP 44.— ● **Microdus minutus**
× **Microcampylopus perpusillus**

weakly thickened; peristome irregular, yellow-brown, fragile, teeth cleft and perforated, 50–150 μm high, ornately papillose throughout; operculum rostrate, 0,8 mm long, cells not twisted; calyptra cucullate; spores round, 20 μm, yellow-brown, papillose. Fig. 33: 9–16.

This species is presently known from the East African Islands, and from eastern and Southern Africa. In the Flora area it is infrequently collected in grasslands of the central and southern Transvaal, Swaziland and Natal. The species has also been collected in the southern and southwestern Cape. Map 44.

Vouchers: *Cholnoky* 248; *Magill* 3421, 4279.

This species could easily be mistaken for a *Dicranella*, but it is distinguished by short, narrow, lanceolate to elliptical leaves without pronounced shoulders, by non-ribbed, oval capsules, and rudimentary peristomes that are papillose throughout.

Subfamily DICRANOIDEAE

Plants small to large, in loose tufts, dark green, yellow-green or light green; terricolous, saxicolous or corticolous. *Stems* erect, occasionally tomentose below; central strand present or absent. *Leaves* erect to falcate-secund, generally narrow, elongate; lamina unistratose; margins serrate to entire, frequently bordered by several rows of narrow, hyaline cells or marginal cells undifferentiated. *Costa* percurrent to excurrent, narrow or occupying up to $\frac{4}{5}$ of leaf base; in section with dorsal and ventral stereid bands or ventral cells thin-walled, frequently strongly differentiated. *Laminal cells* quadrate, rectangular, rhomboidal or rarely linear, smooth, mammillose or papillose, occasionally pitted; basal cells rectangular; alar cells frequently strongly differentiated.

Perichaetia terminal or lateral through innovation, leaves undifferentiated or base long-sheathing. *Seta* long, erect, flexuose or curved; capsules cylindrical; peristome teeth well developed, cleft to middle, vertically striolate below, or infrequently irregularly perforated to rudimentary; operculum rostrate; calyptra cucullate, base entire or fimbriate.

Key to Genera of Subfamily Dicranoideae

1 Alar cells not differentiated:
  2 Costa broad, flattened in cross section:
    3 Ventral cells of costa numerous, large, completely covering guide cells....6. **Campylopus**
    3 Ventral cells of costa few, small, covering only central guide cells...5. **Microcampylopus**
  2 Costa narrow, rounded in cross section:
    4 Costa ending below apex to percurrent; margins irregularly serrate; leaf cells sharply mammillose dorsally and ventrally.....1. **Oreoweisia**
    4 Costa mucronate; margins entire; alar cells distinct but usually broken away; leaf cells domed ventrally, smooth dorsally or weakly papillose juxtacostally..... 2. **Holomitrium**

1 Alar cells distinct:

5 Leaves with differentiated border of narrow, hyaline cells; costa narrow:

6 Upper leaf cells strongly papillose, with large stellate or spinose papillae or with numerous small papillae scattered over lumen; leaf cells generally quadrate above base.....4. **Leucoloma**

6 Upper leaf cells smooth, mostly elongate.....3. **Dicranoloma**

5 Leaves without distinct hyaline border:

7 Laminal cells domed ventrally, smooth dorsally or juxtacostal cells weakly papillose; costa narrow.....2. **Holomitrium**

7 Laminal cells smooth dorsally and ventrally; costa very broad, generally with lamellae or sharply mammillose cells on dorsal surface:

8 Leaves falcate-secund; dorsal costal cells sharply mammillose; basal laminal cells only weakly differentiated.....7. **Chorisodontium**

8 Leaves rigidly erect; dorsal costa smooth, rough or with lamellae, cells not sharply mammillose; basal laminal cells moderately differentiated...6. **Campylopus**

1. OREOWEISIA

Oreoweisia (*B.S.G.*) *De Not.* in Epil. 1: 489 (1869); Broth. in Natürl. PflFam. 10: 197 (1924); Sim, Bryo. S. Afr. 250 (1926). Type species: *O. serrulata* (Funck) De Not.

Weissia subgenus *Oreoweisia* B.S.G., Bryol. Eur. 1: 71 (1846).

Plants small, in tufts; terricolous. *Stems* erect, occasionally branched; central strand present. *Leaves* strap-shaped; apex obtuse; margins bluntly serrate. *Costa* pronounced, ending just below apex; in section round, with dorsal stereid band only. *Laminal cells* irregularly quadrate, mammillose, incrassate.

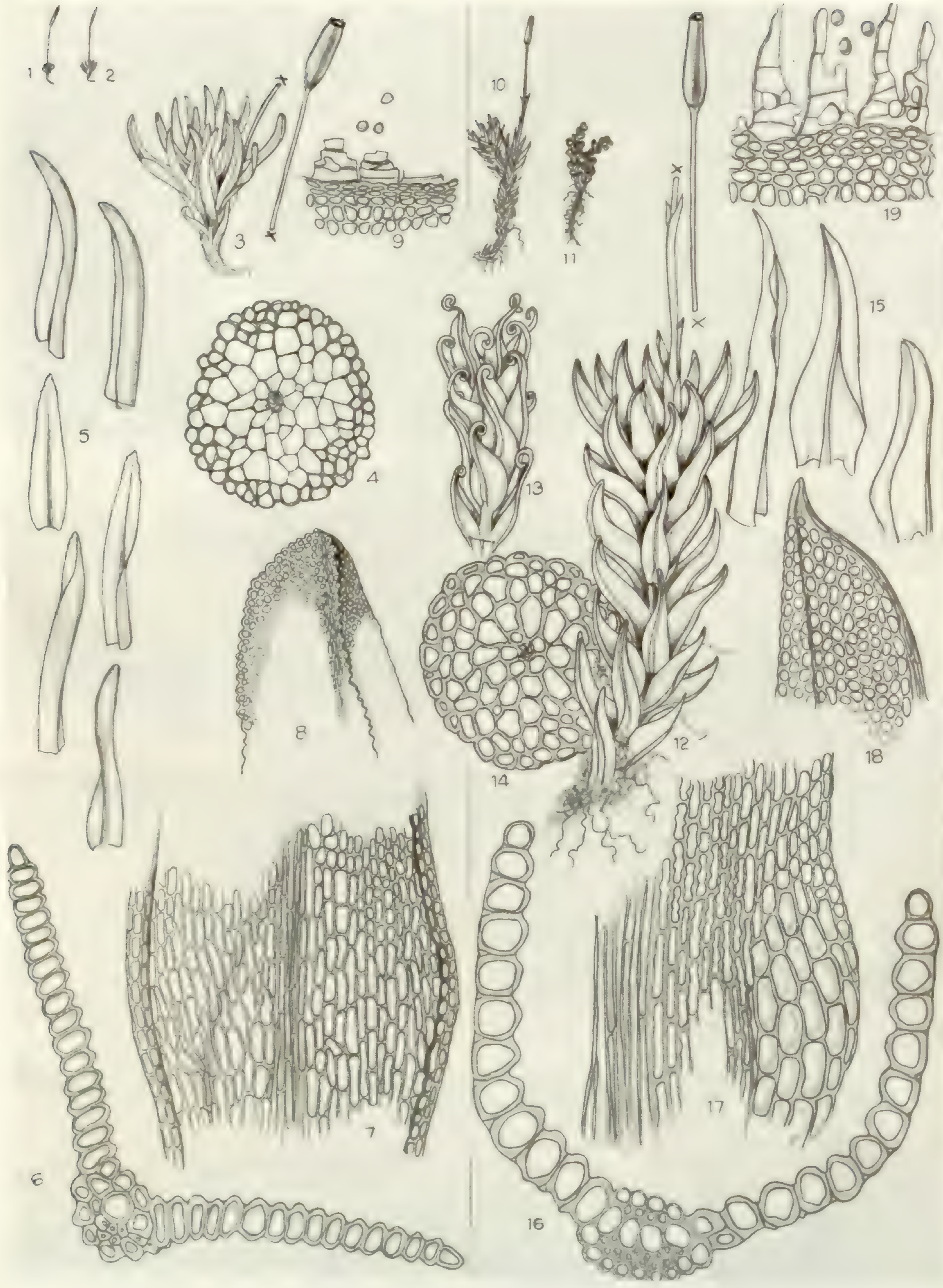
Oreoweisia is a widespread genus with 18 species. The highest concentration of species (8) is found in South America. Two species are known from Africa, *O. bruntonii* (Sm.) Mild. of northern Africa and Europe and the Southern African endemic *O. erosa*. The latter was treated by Sim (1926) under Pottiaceae; careful examination, however, reveals its relationship to Dicranaceae. In the absence of sporophytes, the erose leaf margins, strongly mammillose leaf cells and costal anatomy will help to identify specimens.

Oreoweisia erosa (*C. Müll.*) *Kindb.*, Enum. Bryin. Exot. 69 (1888); Broth. in Natürl. PflFam. 10: 198 (1924); Sim, Bryo. S. Afr. 250 (1926). Type: Cape, *Ecklon* s.n.

Weissia erosa Hampe ex C. Müll. in Bot. Ztg 16: 163 (1858).

Plants small, in loose tufts, dark green to yellow-green; terricolous. *Stems* erect, to 10 mm tall, radiculose below; in section subround, central strand present, inner cortical cells in 3 rows, large, outer cortical cells in 1–2 rows, small, incrassate, reddish. *Leaves* crisped when dry, patent wet; ligulate, 1,2–2,0 mm long; apex obtuse, occasionally acute, frequently weakly cucullate; margins plain, erose to bluntly serrate above. *Costa* prominent, ending just below apex or rarely percurrent; in section guide cells 4, large, ventral cells in single row, incrassate, dorsal stereid band 2 cells thick, dorsal surface cells larger, incrassate. *Laminal cells* irregular, quadrate to angular, sharply mammillose on dorsal and ventral surfaces; basal cells oblong, smooth, hyaline; alar cells not differentiated.

Autoicous. *Perigonia* on lower stem, leaves abruptly ligulate from a broadly oval base. *Perichaetia* lateral through innovation, frequently persistent; leaves not differentiated. *Seta* erect, 5–6 mm long, reddish yellow; capsule short-cylindrical, 1,5 mm long, reddish yellow; peristome fragile,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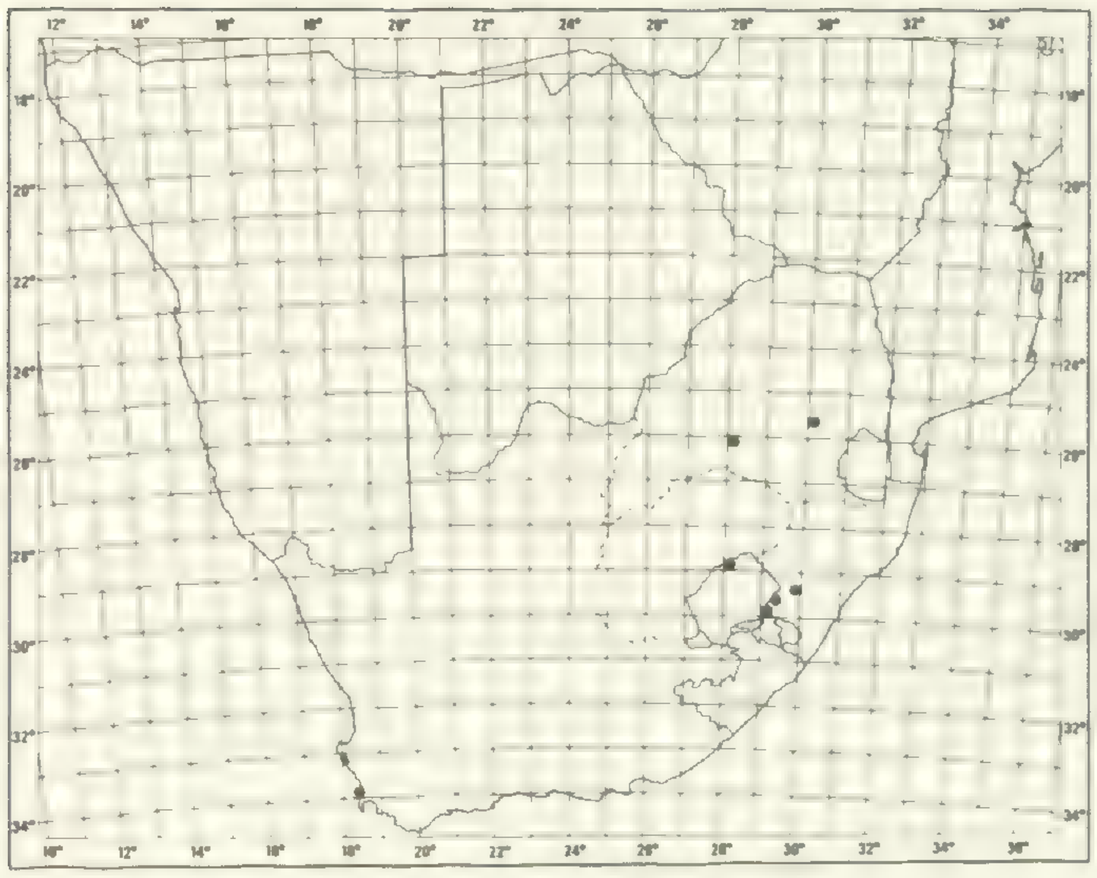


MAP 45.— ● **Oreoweisia erosa**

teeth irregularly perforated, yellowish, smooth; spores round, 20–22 μm, papillose. Fig. 34: 1–9.

Endemic to Southern Africa. Originally described from the southwestern Cape, *O. erosa* has been infrequently collected in scattered locations in Natal, Lesotho and Transvaal. Only a single collection was seen from the southwestern Cape. Map 45.

Vouchers: *Esterhuysen* 15365; *Magill* 4307, 4486; *Sim* 8047, 10059; *Wager* 1441.

Despite the obvious problem of a macroscopic resemblance to taxa of Pottiaceae, it is unlikely that *O. erosa* will be confused with any other pottiaceous or dicranaceous species. The distinctly erose upper leaf margins and the strong mammillae on both dorsal and ventral cell surfaces will help to identify the species. Dixon (in Sim, 1926) compares the type of *O. erosa* to the Northern Hemisphere species *O. torquescens* (Brid.) Wijk & Marg. (=*O. serrulata* (Funck) De Not.).

2. HOLOMITRIUM

Holomitrium *Brid.*, Bryol. Univ. 1: 226 (1826); Broth. in Natürl. PflFam. 10: 201 (1924); Sim, Bryo. S. Afr. 161 (1926). Type species: *H. perichaetiale* (Hook.) Brid.

Plants medium to large, forming dense tufts; saxicolous or corticolous. *Stems* erect, branching; central strand present. *Leaves* squarrose above erect bases. *Costa* short-excurrent; in section round, with dorsal and ventral stereid bands. *Upper laminal cells* rounded-quadrate, incrassate, mammillose ventrally; alar cells differentiated.

Perichaetial leaves very long, convolute; apices sometimes reaching capsule base. *Capsule* cylindrical; peristome teeth 16, irregular, perforated or cleft to base.

Only 8 of the 60 species presently recognized in *Holomitrium* are found outside the tropics. The greatest concentration of species is found at high altitudes in Central and South America. In Southern Africa *Holomitrium* is restricted to the fynbos biome of the southern Cape and the alpine grass-heath biome of Lesotho and western Natal, and the forests of northern Transvaal.

Holomitrium cylindraceum (*P. Beauv.*) *Wijk & Marg.* var. **cucullatum** (*Besch.*) *Wijk & Marg.* in Taxon 9: 190 (1960). Type: Reunion, *Menzies* s.n.

Holomitrium vaginatum (Hook.) Brid. fo. *cucullatum* Besch. in Annls Sci. nat. Bot., sér. 6, 9: 328 (1880).—var. *cucullatum* (Besch.) C. Müll., Gen. Musc. Fr. 254 (1900).

Holomitrium affine Card. & Thér. in Bull. Soc. bot. Genève, sér. 2, 3: 249 (1911); Broth. in Natürl. PflFam. 10: 201 (1924); Sim, Bryo. S. Afr. 161 (1926). Syntypes: Natal, *Medley Wood* 712b (NH!; H); Tanzania, Usambara, *Holst* 4215a, 2627a, 4209 (H; PC); Bourbon, *Rodriques* s.n. (PC); St Philippe, *Rodriques* s.n. (PC); Mauritius, *Robillard* s.n. (PC); *Voeltz* s.n. (PC).

Plants of medium size, in loose tufts, dark green to light green above; saxicolous or corticolous. *Stems* erect, 10–20 mm tall, frequently branched, tomentose below; in section round, central strand present, small, inner cortical cells of medium size, in 5–6 rows, outer cortical cells in single row, small, incrassate, yellow-brown. *Leaves* circinate above erect base dry, squarrose above base

FIG. 34.—**Oreoweisia erosa** (1–9): **1.** habit, dry, ×1; **2.** habit, wet, ×1; **3.** habit, wet, ×4; **4.** stem in cross section, ×130; **5.** leaves, ×15; **6.** leaf in cross section, ×300; **7.** leaf base, ×100; **8.** leaf apex, ×170; **9.** part of capsule mouth with rudimentary peristome teeth and spores, ×75. **Holomitrium cylindraceum** var. **cucullatum** (10–19): **10.** habit, wet, ×1; **11.** habit, dry, ×1; **12.** habit, wet, ×4; **13.** habit, dry, ×4; **14.** stem in cross section ×130; **15.** leaves, ×10; **16.** leaf in cross section, ×300; **17.** cells at leaf base (right side), ×100; **18.** leaf apex, ×100; **19.** part of capsule mouth with peristome teeth and spores, ×120. (1–9, *Sim* 8047; 10–19, *Crosby & Crosby* 8070).

wet, keeled; acuminate above an obovate base, 2,5–4,0 mm long; apex acute, cucullate, mucronate; margins erect, entire. *Costa* short-excurrent; in section guide cells 2, large, ventral substereid band 1 cell thick (absent in distal section), ventral surface cells slightly larger, incrassate, dorsal stereid band 2 cells thick, dorsal surface cells larger, incrassate. *Upper laminal cells* quadrate to rounded, or some short-rectangular, extending down margins of upper base, mammillose ventrally; juxtacostal cells papillose dorsally; basal cells oblong, becoming longer near costa, longitudinal walls irregularly incrassate to weakly nodose, pitted; alar cells enlarged, weakly thickened, yellowish.

Perichaetia terminal, leaves long convolute, oblong, abruptly short-acuminate, 8–10 mm long; leaf cells oblong throughout. *Seta* 10–13 mm long, yellow; capsule erect, urn cylindrical to ovate-cylindrical, 3,0–3,5 mm long, yellowish; peristome yellowish red, teeth irregularly perforated or cleft to base, finely ornate-papillose; operculum rostrate; calyptra cucullate; spores round, 14–17 μm, granulate. Fig. 34: 10–19.

Holomitrium cylindraceum var. *cucullatum* is found in Africa south of the Sahara and the East African Islands. In Southern Africa, the species occurs on trees and rocks in forests of the southern and southwestern Cape, Drakensberg Escarpment of western Natal and Soutpansberg of northern Transvaal. Map 46.

MAP 46.—● **Holomitrium cylindraceum** var. **cucullatum**

Vouchers: *Crosby & Crosby* 8095; *Owen* 8; *Russell* 2561; *Thorne* PRE-CH6433; *Von Breitenbach* 177; *Wager* PRE-CH1514.

Fertile plants are easily identified by the long, sheathing perichaetial leaves. The vegetative leaves, broadly reflexed above the erect obovate base and cucullate apex, will help to identify sterile plants. The narrow, weakly nodose basal cells strongly contrast with the enlarged, yellowish alar cells. The latter, however, are easily broken away when the leaves are removed from the stem.

3. DICRANOLOMA

Dicranoloma (*Ren.*) *Ren.* in Rev. Bryol. 28: 85 (1901); Broth. in Natürl. PflFam. 10: 207 (1924); Sim, Bryo. S. Afr. 162 (1926). Type species: not designated.

Plants large to robust, forming large, loose cushions; saxicolous. *Stems* erect, branching; central strand present or absent. *Leaves* erect to spreading wet or dry, frequently secund. *Costa* frequently weak; in section subround to oval, stereid bands present. *Laminal cells* incrassate, smooth; alar cells distinct, enlarged, coloured; border cells narrow, hyaline.

Perichaetia lateral through innovation, leaves distinct. *Seta* erect; capsule curved or erect; peristome cleft above, striate below; operculum rostrate; calyptra cucullate.

A genus of 114 species, *Dicranoloma* is best represented in Australasia. Of the 6 species recognized in Africa, *D. billardieri* is the most widespread. In Southern Africa the genus is rare in forest of the fynbos and montane forest biomes.

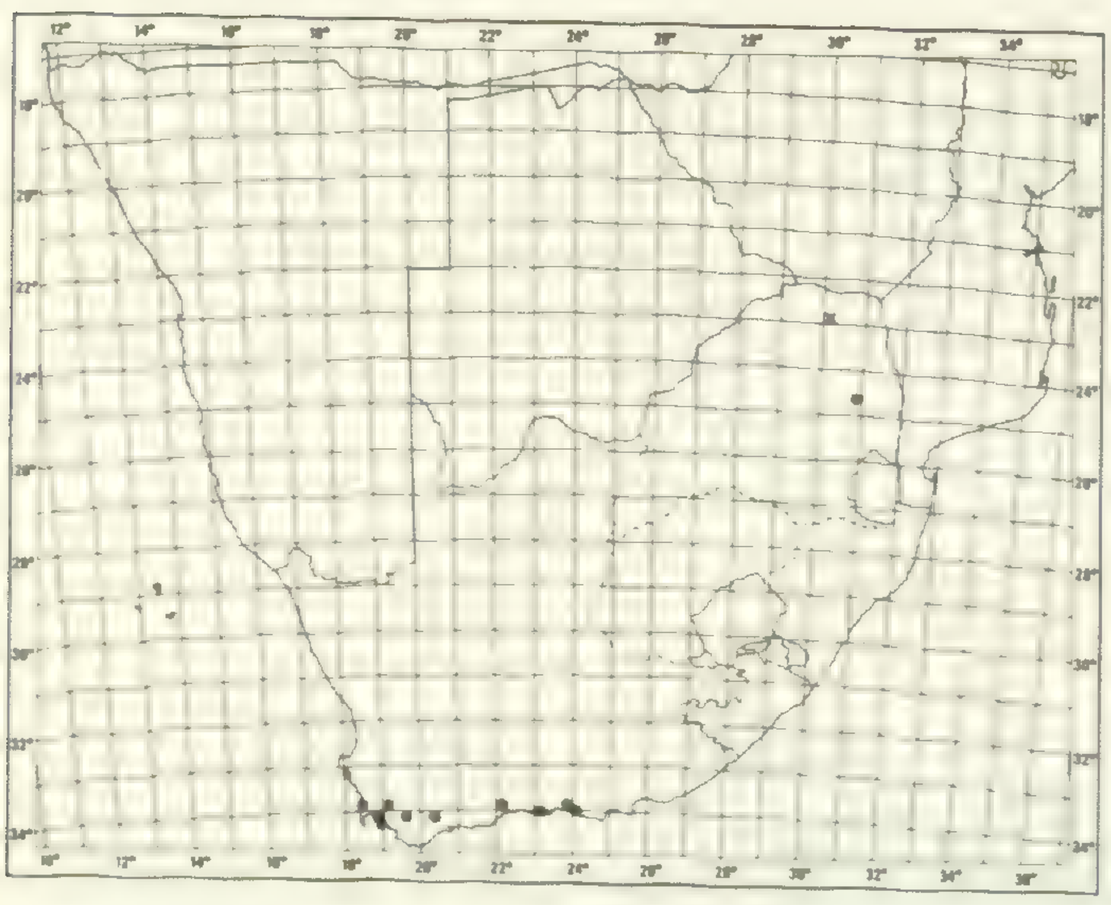
1 Leaf cells strongly incrassate, pitted; alar cells quadrate to short-rectangular.....1. *D. billardieri*
1 Leaf cells ± thin-walled, non-porous; alar cells oblong below, upper row quadrate.....2. *D. entabeniense*

FIG. 35.—**Dicranoloma entabeniense** (1–8): **1.** habit, ×1; **2.** branch, dry, ×1; **3.** habit, ×3; **4.** leaves, ×10; **5.** leaf in cross section, ×170; **6.** cells at leaf base (right side), ×90; **7.** lower laminal cells at margin, ×220; **8.** upper laminal cells in subula, ×220. **D. billardieri** (9–17): **9.** habit, ×1; **10.** habit, ×4; **11.** stem in cross section, ×110; **12.** leaves, ×10; **13.** leaf in cross section, ×250; **14.** cells at leaf base (right margin), ×90; **15.** upper laminal cells, ×320; **16.** perichaetial leaves, ×5; **17.** part of capsule mouth with peristome teeth, ×55. (1–8, *Bottomley* PRE-CH3381; 9–10, 12 & 14–17, *Boucher* 2209; 11 & 13, *Crosby & Crosby* 8140).

1. **Dicranoloma billardieri** (*Brid.*) *Par.*, Ind. Bryol. 2: 24 (1904); Broth. in Natürl. PflFam. 10: 209 (1924); Sim, Bryo. S. Afr. 162 (1926). Type: Australia, *Billardier* s.n.

Dicranum billardieri Brid. in Bot. Ztg, Regensburg 1: 214 (1802).

Plants large to robust, in loose cushions, dark green to yellowish green, blackish below; saxicolous. *Stems* erect, 60–70 mm high, branched above; in section round, central strand small, inner cortical cells large, thick-walled, outer cortical cells in 1–2 rows, stereids, reddish. *Leaves* erect-spreading to secund; ovate-subulate, 4,5–5,0 mm long; base rounded; margin entire below, serrate in subula, plane below, inflexed above, bordered from base to acumen by 1–2 rows of narrow, elongated cells. *Costa* weak, narrow, ending in apex or occasionally absent in some leaves; in section subround, guide cells 2, dorsal and ventral stereid bands 1(–2) cells thick, exposed. *Upper laminal cells* elliptical, incrassate, pitted, becoming longer toward base; basal cells oblong, strongly incrassate, pitted; border cells long–linear, hyaline, smooth, in cross section substereids; alar cells enlarged, reddish brown, quadrate to hexagonal or short-rectangular, to 8 cells high; basal juxtacostal cells reddish brown, oblong, incrassate, pitted, not enlarged.



MAP 47.— ● **Dicranoloma billardieri**
× **Dicranoloma entabeniense**

Perichaetia terminal, leaves sheathing, 6–7 mm long, apex obtuse. *Seta* erect, 15–20 mm long, red; capsule arcuate, 3 mm long, strumose, reddish; peristome teeth 16, orange, vertically striolate or papillose, occasionally perforated below, cleft to near middle, apical segments striolate, yellowish; operculum long-rostrate, 2 mm long; spores round, 12–15 μm. Fig. 35: 9–17.

Although widespread in the Southern Hemisphere, *D. billardieri* is restricted, in Southern Africa, to the southern and southwestern Cape, primarily around Table Mountain, and a few locations in the eastern Transvaal. In Africa the species is found in montane forest and ericaceous heath as far north as Kilimanjaro in Tanzania (Bizot et al., 1978). Map 47.

Vouchers: *Bews* 8471; *Boucher* 2209; *Crosby & Crosby* 8140; *Goldblatt* 1661A; *Howes* 6; *Vorster* 765.

This species is separated from *D. entabeniense* by strongly incrassate, pitted median leaf cells and quadrate alar cells. In addition the habitats of the two species are quite distinct.

2. **Dicranoloma entabeniense** *Magill* in Mem. bot. Surv. S. Afr. 43: 3 (1979). Type: Transvaal, Soutpansberg, Entabeni Forest, *Bottomley* PRE-CH3381 (PRE, holo.!; H; L; MO; NY).

Plants large, in lax tufts; saxicolous. *Stems* erect, to 60 mm tall, branched above; in section round, central strand absent, inner cortical cells large, becoming smaller, incrassate toward margin, red-brown, outer cortical cells in single row, substereids, red-brown. *Leaves* appressed with flexuose tips dry, spreading wet; ovate to oblong, subulate above, 5,0–5,5 mm long; base weakly auriculate; margins entire, plane below, convolute above; hyaline border extending from base to near apex, 2–6 cells wide below. *Costa* short-excurrent, toothed at tip; in section oval, guide cells 6, ventral stereid band 2 cells thick, exposed, dorsal cells slightly smaller than guide cells, incrassate, dorsal surface cells in single row, stereids. *Upper laminal cells* smooth, subquadrate; median cells shortly rectangular, extending to base juxtacostally, arranged in ± longitudinal rows; border cells long-linear, hyaline; alar cells enlarged, reddish brown, long-rectangular, extending to costa or cells near costa narrow and not enlarged, upper row of alar cells quadrate.

Sporophyte not known. Fig. 35: 1–8.

This species is presently known only from dry forests of the northern Transvaal. Map 47.

Voucher: Type only.

The narrow costa, differentiated alar cells, bordered leaves and smooth leaf cells of this species are characteristic of *Dicranoloma*. It is distinct from the other Southern African species, *D. billardieri* by its non-porous, shortly rectangular leaf cells and oblong alar cells.

Insufficiently Known Species

Dicranoloma nitidulum (C. Müll.) Par., Ind. Bryol. edn 2, 2: 28 (1904). Basionym: *Dicranum nitidulum* C. Müll. in Hedwigia 38: 88 (1899). Type: Cape, Table Mountain, sin. coll., July 1883, Herb. Schliephacke. The type has not been seen; however Sim (1926) refers the species to *D. billardieri* (Brid.) Par.

4. LEUCOLOMA

Leucoloma *Brid.*, Bryol. Univ. 2: 218 (1827); Broth. in Natürl. PflFam. 10: 209 (1924); Sim, Bryo. S. Afr. 163 (1926). Type species: *L. bifidum* (Brid.) Brid.

Plants small to large, in loose tufts, green to glaucous-green; saxicolous or corticolous. *Stems* erect, to 60 mm high, sparsely radiculose; in section round, central strand absent. *Leaves* flexuous or secund dry; lanceolate to ovate, setaceous or subulate; base weakly auriculate; margins frequently convolute, bordered throughout, wide below. *Costa* narrow, ending in apex; in section oval, with dorsal and ventral stereid bands. *Laminal cells* short, strongly papillose above; border cells long-linear, hyaline; intermediate cells smooth, rectangular; juxtacostal cells variable; alar cells differentiated, enlarged and coloured.

Dioicous. Perichaetia terminal. *Seta* erect; capsule straight, cylindrical; peristome divided to middle; operculum rostrate; calyptra cucullate.

The 131 species of *Leucoloma* are primarily tropical in distribution. The greatest concentration of species is found on the East African Islands and in Central Africa. In Southern Africa *Leucoloma* is found on rock or wood, in forests, from Table Mountain to Natal and the eastern and northern Transvaal.

The genus is divided from other members of the subfamily by its strong leaf border of hyaline cells and papillose upper leaf cells. The leaves are also distinct in having as many as three other types of cells, e.g. differentiated alar cells, intermediate cells lying between the border and upper leaf cells, and distinct basal leaf cells.

1 Papillose, quadrate laminal cells extending to base juxtacostally.....1. *L. chrysobasilare*

1 Basal cells rectangular, smooth, differing from laminal cells:

2 Median and lower leaf cells with several papillae scattered over lumen.....2. *L. sprengelianum*

2 Median and lower leaf cells generally with a single stellate or spinose papilla over lumen, occasionally a few cells with two papillae:

3 Leaves short, to 3,0 mm long, hyaline border narrow below, to 6 cells wide....3. *L. syrrhopodontioides*

3 Leaves longer, 2,5–6,0 mm long, hyaline border wide below, 12 or more cells wide.....4. *L. rehmannii*

1. **Leucoloma chrysobasilare** (*C. Müll.*) *Jaeg.*, Adumbratio 2: 643 (1880); Broth. in Natürl. PflFam. 10: 210 (1924); Sim, Bryo. S. Afr. 165 (1926). Syntypes: Comoro Islands, *Hildebrandt* 1840 (BM!), 1842, 1846.

Dicranum chrysobasilare C. Müll. in Linnaea 40: 238 (1876).

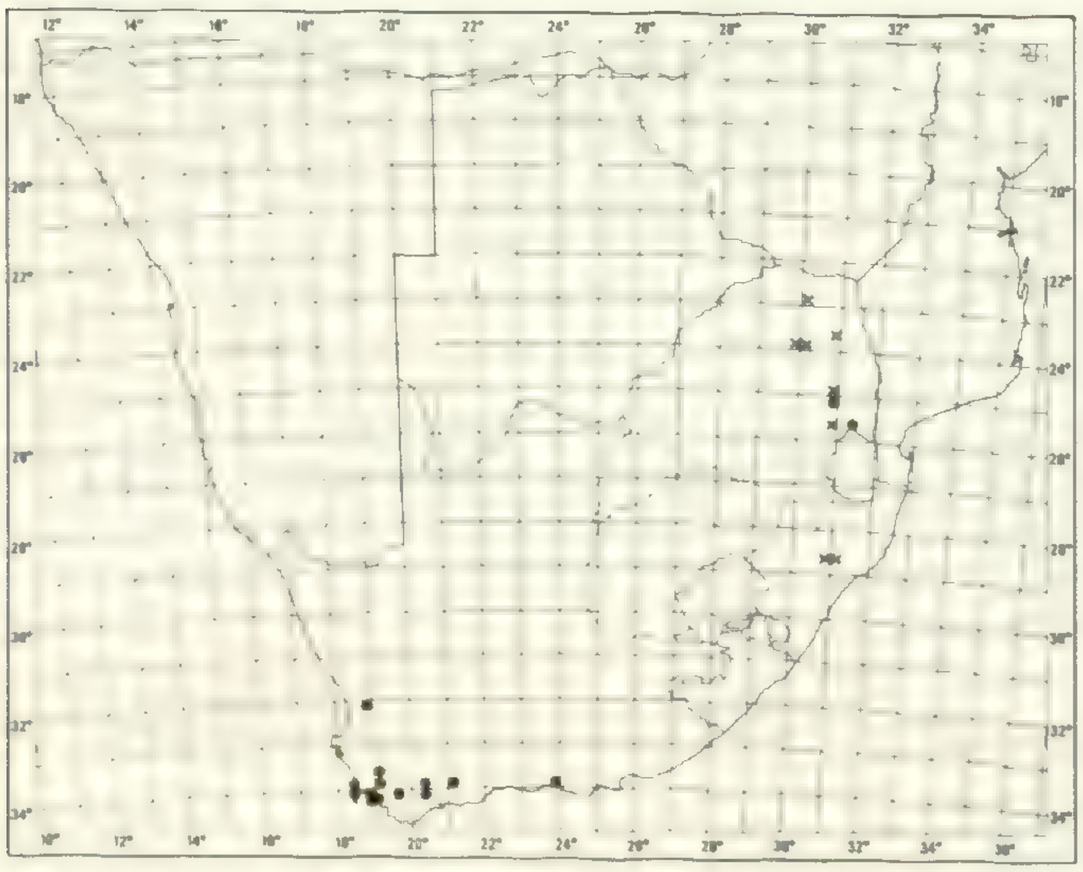
Leucoloma zuluense Broth. & Bryhn in Forh. VidenskSelsk. Krist. 1911 (4): 6 (1911); Broth. in Natürl. PflFam. 10: 210 (1924). Type: Natal, Zululand, Ekombe, *Titlestad* s.n., July 1907, (H-BR!).

Plants large, in loose tufts, yellowish to light green; corticolous or saxicolous. *Stems* erect, 50–60 mm tall, occasionally branched; in section central strand absent, inner cortical cells in 5–8 rows, small, incrassate, outer cortical cells in 2–3 rows of stereids or substereids, reddish. *Leaves* erect with tortuous tips dry, erect spreading wet; ovate-subulate, 3,5–5,0 mm long; apex weakly toothed; margins plane, entire to serrate above, bordered throughout by narrow, hyaline cells, 2–6 cells wide below, 1–2 cells wide in subula. *Costa* narrow, ending in apex or rarely short-excurrent; in section guide cells 4, thickened, ventral and dorsal stereid band 2 cells thick, occasionally some cells substereids, surface cells undifferentiated. *Lami-*

nal cells quadrate to short-rectangular, generally thickened, extending to leaf base juxtacostally, bulging dorsally, with several low papillae over lumen, ventral surface flat, smooth; intermediate cells rectangular to long-rectangular, smooth; alar cells distinct, large, quadrate to short-rectangular, yellowish brown, extending across entire leaf base, quadrate near costa.

Immature perichaetial leaves similar to vegetative leaves, papillose leaf cells not reaching leaf base. Sporophyte not known. Fig. 36: 11–17.

Originally described from the Comoro Islands, *L. chrysobasilare* is now known from Madagascar and the forests of East Africa and south through Zimbabwe and Mozambique to the northern and eastern Transvaal, Natal and Zululand. Map 48.



MAP 48.— ● **Leucoloma sprengelianum**
× **Leucoloma chrysobasilare**

Vouchers: *Crosby & Crosby* 7630, 7722; *Magill* 4914; *Sim* 236; *Vorster* 1537; *Wager* 54.

Leucoloma chrysobasilare is related to *L. sprengelianum* but easily separated by the short, papillose leaf cells extending to the leaf base on both sides of the costa. In addition, in Southern Africa, *L. chrysobasilare* is restricted to the northern and eastern Transvaal. *L. sprengelianum* is most common in the Cape, although a few collections have been made in the eastern Transvaal.

The description of the sporophyte of *L. chrysobasilare* by Sim (1926) was in error; the specimen *Wager* 188 (as *Sim* 7728 PRE!) is *L. rehmannii.*

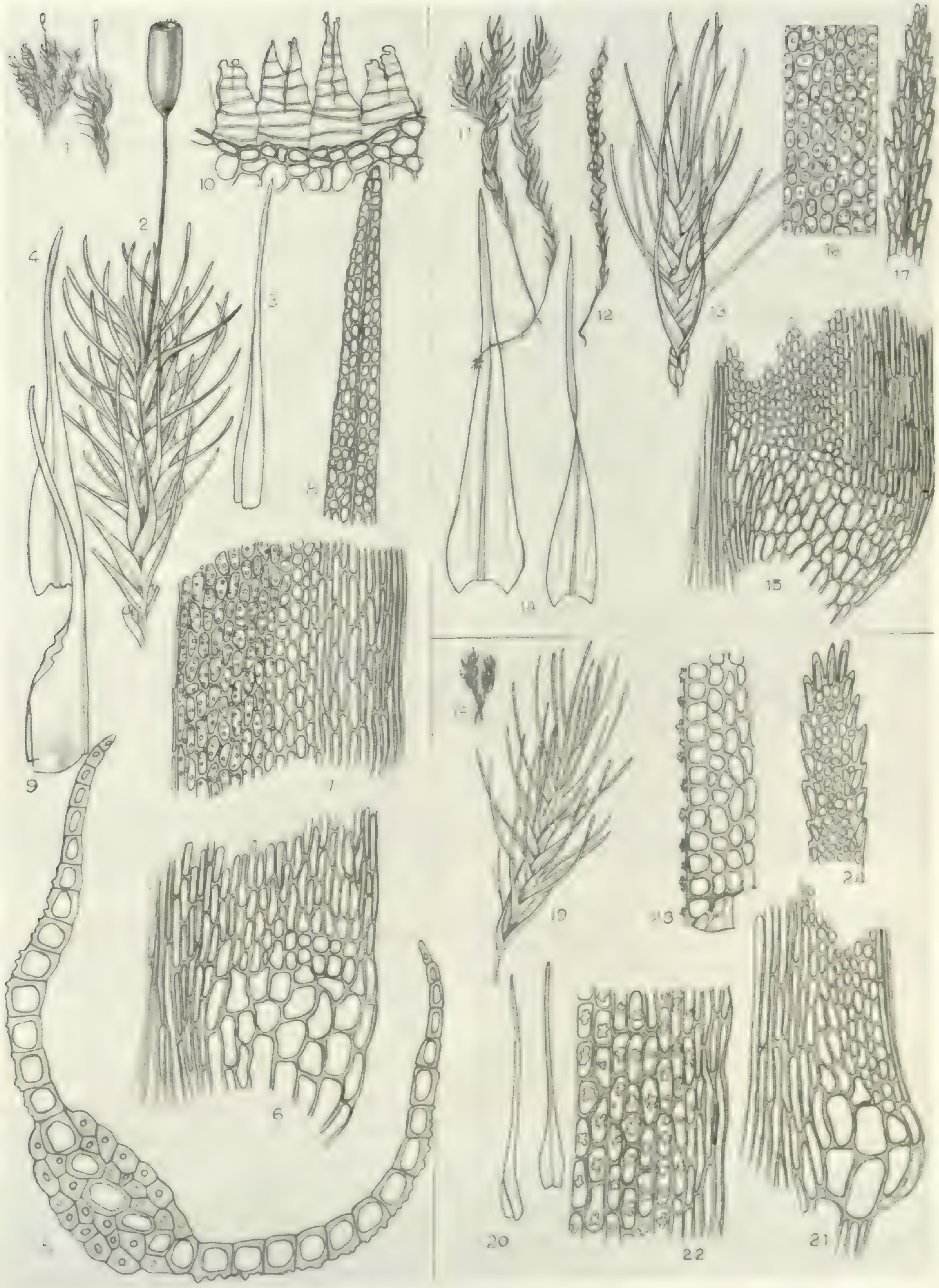
2. **Leucoloma sprengelianum** (*C. Müll.*) *Jaeg.*, Adumbratio 1: 115 (1871); Broth. in Natürl. PflFam. 10: 211 (1924); Sim, Bryo. S. Afr. 164 (1926). Type: Prom. bonae spei, *Sprengel* (BM!).

Dicranum sprengelianum C. Müll., Syn. Musc. 1: 353 (1848).

Dicranum zeyheri C. Müll., Syn. Musc. 1: 353 (1848). *Leucoloma zeyheri* (C. Müll.) Kindb., Enum. Bryin. Exot. 64 (1888); Broth. in Natürl. PflFam. 10: 211 (1924); Sim, Bryo. S. Afr. 163 (1926). Type: Cape, *Zeyher* 496.

Plants medium-sized, in loose tufts, yellowish green to green; terricolous or saxicolous. *Stems* erect, 10–30 mm tall, little branched; in section central strand absent, inner cortical cells incrassate, in 8 rows, smaller toward margin, outer cortical cells in 1–2 rows, smaller, substereids, reddish. *Leaves* erect to secund dry, spreading wet, occasionally falcate; ovate to oblong, subulate, 3–4 mm long; apex acute, weakly toothed; base weakly auriculate; margins plane to erect, entire or serrulate above; border of hyaline, elongated cells, 3–4 cells wide at base, 1 cell wide above. *Costa* strong, ending in subula; in section guide cells 4, dorsal and ventral stereid bands 1–2 cells thick, surface cells not differentiated. *Laminal cells* quadrate or rounded-quadrate to short-rectangular, dorsally papillose with numerous low blunt papillae over lumen, occasionally apical cells with only one or two stellate or spinose papillae, laminal cells becoming long-rectangular with seriate papillae toward base; intermediate cells few, rectangular, smooth, quickly merging with long-rectangular, incrassate basal cells; alar cells enlarged, quadrate to rectangular, reddish brown.

FIG. 36.—**Leucoloma sprengelianum** (1–10): **1.** habit, ×1; **2.** habit, ×10; **3–4.** leaves, ×12; **5.** leaf in cross section, ×435; **6.** cells at leaf base (right side), ×170; **7.** lower laminal cells at margin, ×220; **8.** leaf apex, ×170; **9.** perichaetial leaf, ×12; **10.** part of capsule mouth with peristome teeth, ×100. **L. chrysobasilare** (11–17): **11.** habit, wet, ×1; **12.** habit, dry, ×1; **13.** upper stem, ×10; **14.** leaves, ×12; **15.** cells at leaf base (right side), ×170; **16.** upper laminal cells, ×220; **17.** leaf apex, ×170. **L. syrrhopodontioides** (18–24): **18.** habit, ×1; **19.** habit, ×10; **20.** leaves, ×12; **21.** cells at leaf base (right side), ×170; **22.** lower laminal cells at margin, ×260; **23.** upper laminal cells, ×260; **24.** leaf apex, ×170. (1–10, *Magill & Schelpe* 4051; 11–17, *Von Breitenbach* 168; 18–24, *Vorster* 1452).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Perichaetial leaves sheathing, broadly ovate, abruptly subulate, 3 mm long. *Seta* straight, 9–10 mm long, reddish; capsule short-cylindrical, to 1 mm long; peristome reddish yellow, teeth divided above, occasionally perforated below, vertically striate below, papillose above; spores round, 25 μm, weakly papillose. Fig. 36: 1–10.

Endemic to Southern Africa, *L. sprengelianum* is collected on soil and rock in the fynbos biome of the southern and southwestern Cape. A few collections have also been made in the forests of the eastern Transvaal. Map 48.

Vouchers: *Barnard* PRE-CH3101; *Cholnoky* 1107; *Schelpe* 7825; *Sim* 9123; *Wager* PRE-CH381.

Some specimens have well-developed stellate papillae on the leaf cells; but only a few cells will have only single papillae. Even in these specimens there is little difficulty with identification since the lower leaf cells, near the junction with the intermediate cells, are always rectangular with several papillae per cell. Specimens of *L. rehmannii* and *L. syrrhopodontioides* have quadrate or short-rectangular lower leaf cells, with one or rarely two papillae per cell.

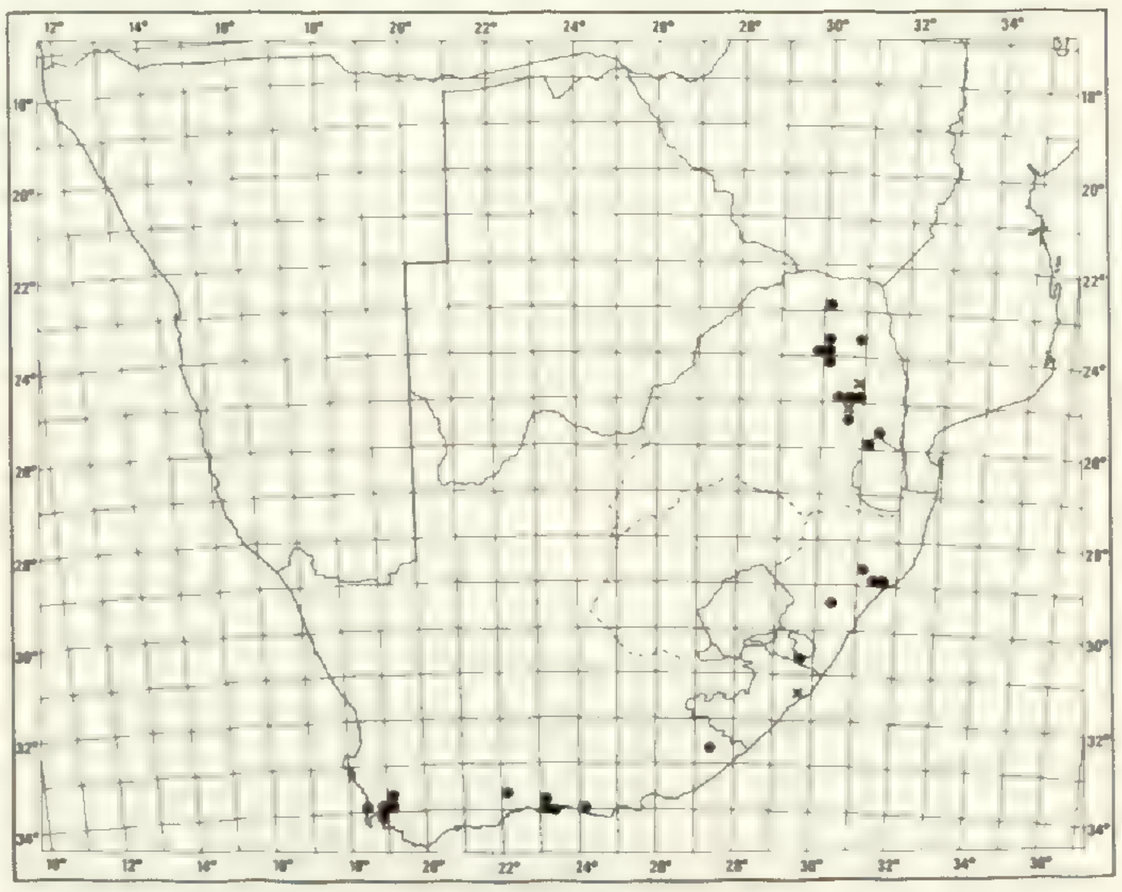
Examination of the type of *L. zeyheri* shows that it is conspecific with *L. sprengelianum*. Although older collections labelled *L. zeyheri* are generally *L. sprengelianum*, most recent collections, referred to *L. zeyheri*, are small forms of *L. rehmannii*. The species are similar in habit and, to some extent, distribution; although *L. rehmannii* is more common, especially in the Transvaal. The two species can be easily separated on the basis of leaf cell ornamentation: *L. sprengelianum* (=*L. zeyheri*) has numerous low, blunt papillae scattered over the dorsal leaf surface, and the papillae are seriate on cells just above the base; in *L. rehmannii* each cell has a single, large, stellate papilla on the dorsal surface. These large papillae occur from just above the basal leaf cells to the apex, where they become large, unbranched spinose papillae. Although some variation occurs in both species (vide descriptions) this character has been effective in separating the two species.

3. **Leucoloma syrrhopodontioides** *Broth.* in Bot. Jb. 24: 236 (1897); Broth. in Natürl. PflFam. 10: 211 (1924); Sim, Bryo. S. Afr. 163 (1926). Type: Transkei, Pondoland, *Bachmann* 10 (H, holo.!).

Plants small, in loose tufts, yellowish green; corticolous. *Stems* erect, to 15 mm high, occasionally branched; in section central strand absent, inner cortical cells in 4 rows, incrassate, outer cortical cells in 1–2 rows of substereids, reddish. *Leaves* flexuose dry, erect-spreading wet; lanceolate-subulate, 2,5–3,0 mm long; apex serrate; margin convolute, entire below, border narrow, ending in subula, to 6 cells wide below. *Costa* ending in subula; in section guide cells 4, dorsal and ventral stereid bands 2 cells thick, surface cells not differentiated. *Laminal cells* quadrate, dorsally papillose, each cell with single, large, stellate papillae over lumen; intermediate cells few, rectangular; basal cells irregular, rectangular to rhomboidal, incrassate; alar cells large, yellowish brown, quadrate to short-rectangular, filling base.

Sporophyte not known. Fig. 36: 18–24.

Described from the Transkei, this species has recently been collected in forests of the eastern Transvaal. Map 49.



MAP 49.— ● **Leucoloma rehmannii**
× **Leucoloma syrrhopodontioides**

Voucher: *Vorster* 1452.

The plants are identified by their narrow border in the leaf base, short leaves and unipapillose cells. Small specimens of *L. sprengelianum* can be mistaken for this species, but its pleuropapillose leaf cells help to distinguish the two species.

4. **Leucoloma rehmannii** (*C. Müll.*) *Rehm. ex Par.*, Ind. Bryol. Suppl. 233 (1900); Broth. in Natürl. PflFam. 10: 211 (1924); Sim, Bryo. S. Afr. 164 (1926). Type: Cape, Blanco, *Rehmann* 29 (BOL!; PRE!).

Dicranum rehmannii C. Müll. in Hedwigia 38: 87 (1899).

Leucoloma haakonii Broth. & Bryhn in Forh. VidenskSelsk. Krist. 1911(4): 6 (1911); Broth. in Natürl. PflFam. 10: 211 (1924). Type: Natal, Zululand, Eshowe, *Bryhn* s.n., January 1909 (H-BR!).

Plants medium to large, in loose tufts, light to yellowish green; corticolous or saxicolous. *Stems* erect, 15–50 mm high; in

section central strand absent, inner cortical cells in 3–4 rows, incrassate, outer cortical cells in 1–2 rows, smaller, incrassate, reddish. *Leaves* falcate to secund dry, erect-spreading wet; lanceolate-subulate, 2,5–5,0(–6,0) mm long; apex acute, toothed; margins weakly convolute above base, entire below, serrate at apex; border wide below, 1–2 cells wide to apex. *Costa* percurrent; in section guide cells 4, dorsal and ventral stereid bands 2 cells thick, surface cells undifferentiated. *Laminal cells* quadrate above, rounded rectangular to elliptical above base, dorsally papillose, with 1(–2) large, stellate papillae over lumen; intermediate cells oblong; basal cells rounded-rectangular to oblong-hexagonal; alar cells enlarged, in 3–4 rows, rectangular below, quadrate above, reddish yellow.

Perichaetial leaves with broad sheathing base, abruptly long-subulate, 4,0–4,5 mm long. *Seta* red, 7,0–7,5 mm long; capsule erect, urn cylindrical, 2,0–2,2 mm long; peristome teeth cleft to middle, weakly papillose, reddish yellow below, distal filaments smooth, yellow; spores round, 17–20 μm, granulate. Fig. 37: 1–10.

Endemic to Southern Africa, *L. rehmannii* is found on wood or rocks in forests of the southwestern, southern and eastern Cape, Natal, Zululand, Swaziland and the eastern and northern Transvaal. Map 49.

Vouchers: *Crosby & Crosby* 8032, 9246; *Junod* 4013a; *Schelpe* 7851; *Smook* 866; *Von Breitenbach* 16; *Vorster* 1430.

Leucoloma rehmannii is separated from other Southern African species by its large, stellate papillae, wide basal hyaline border and longer leaves.

The specimen (*Hφeg* 120, BM!) reported from Southern Africa as *L. albocinctum* Ren. & Card. (Dixon, 1932) belongs here. Examination of specimens from the Cardot Herbarium (PC), indicates that *L. rehmannii* and *L. albocinctum* are similar; however, further study is needed to assess the relationship between the two.

Many of the recent collections referred to *L. zeyheri* belong here; see note under *L. sprengelianum*.

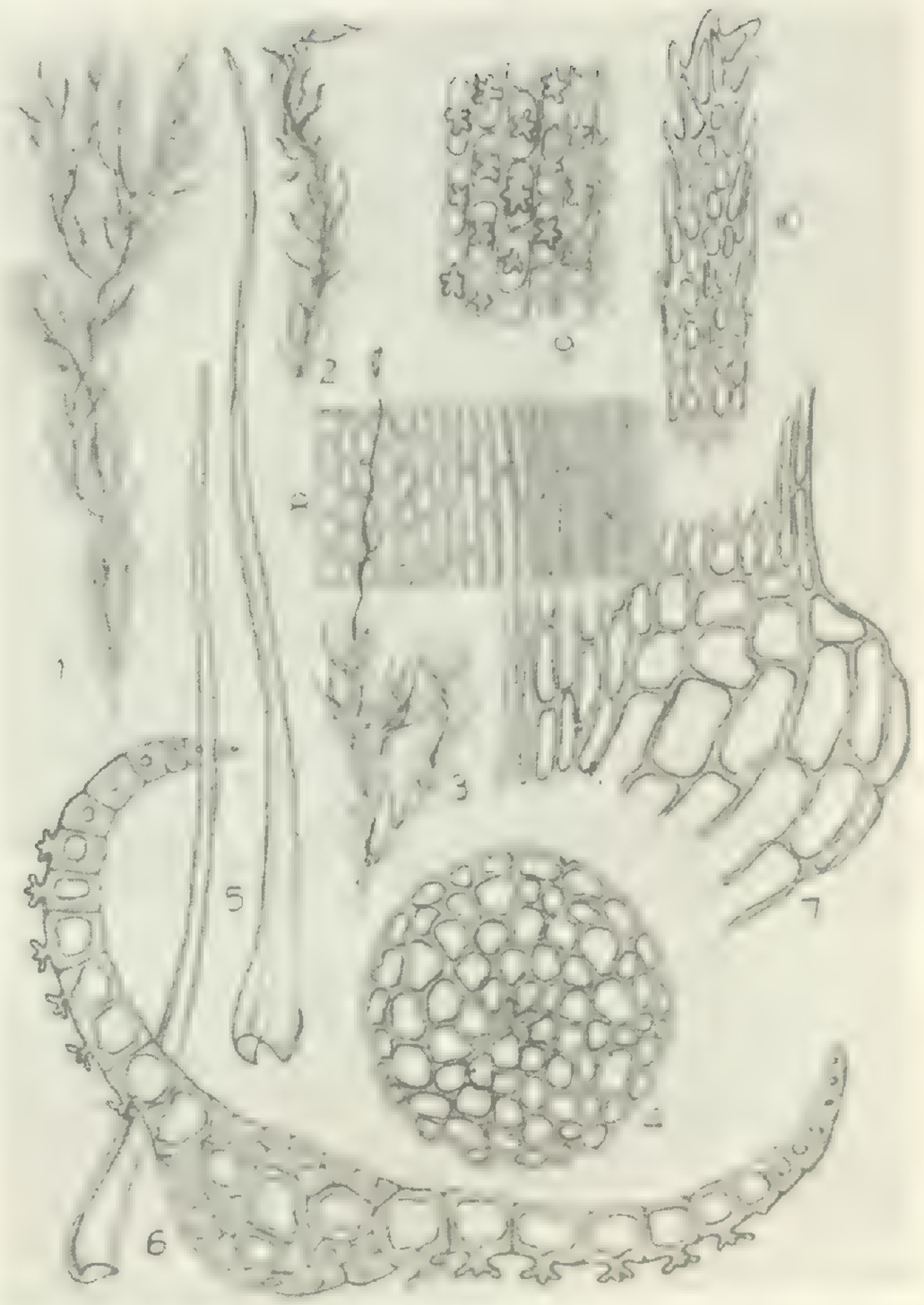


FIG. 37.—**Leucoloma rehmannii**: **1.** habit, wet, ×1; **2.** branch, dry, ×1; **3.** habit, dry, ×1; **4.** stem in cross section, ×140; **5.** leaves, ×12; **6.** leaf in cross section, ×435; **7.** cells at leaf base (right lower margin), ×170; **8.** laminal cells at right margin showing border, ×220; **9.** upper laminal cells, ×350; **10.** leaf apex, ×170. (1–10, *Von Breitenbach* 159).

5. MICROCAMPYLOPUS

Microcampylopus (*C. Müll.*) *Fleisch.*, Musci Fl. Buitenzorg 1: 59 (1904); Broth. in Natürl. PflFam. 10: 183 (1924); Gangulee, Moss. E. India 269 (1971). Type species: *M. subnanus* (C. Müll.) Fleisch.

Campylopus sect. *Microcampylopus* C. Müll. in Hedwigia 38: 77 (1899).

Plants small, caespitose; terricolous. *Stems* simple; central strand present. *Leaves* narrow, linear-lanceolate to oblong-subulate; apex acute to obtuse; margins plane, entire to serrate at apex. *Costa* narrow, excurrent as short, yellowish hair-point or filling subula; in section with small ventral stereid or substereid band; dorsal stereids in small groups, dorsal surface rough. *Laminal cells* quadrate to rectangular, incrassate; basal cells larger, rectangular; alar cells not differentiated.

Dioicous. Perichaetia terminal. *Seta* flexuose or cygneous, yellowish; capsules ovate-cylindrical; peristome teeth cleft to middle, vertically striate below, papillose above; operculum rostrate; calyptra base fringed or entire; spores small.

A small genus of three species, *Microcampylopus* is found in Africa and the East African Islands, India, Asia and Oceania. The single species recognized for Southern Africa, *M. perpusillus*, is found in the eastern Transvaal, and extends northward into East Africa and the East African Islands. *Microcampylopus nanus* is treated under *Dicranella subsubulata*.

Microcampylopus perpusillus (*Mitt.*) *Broth.* in Natürl. PflFam. 11: 525 (1925); Dix. in S. Afr. J. Sci. 20: 314 (1923); Sim, Bryo. S. Afr. 180 (1926). Type: Tanzania, Ugogo, *Hannington* s.n. (BM, holo.!).

Campylopus perpusillus Mitt. in J. Linn. Soc., Bot. 22: 301 (1886).

Campylopus angustinervis Dix. in S. Afr. J. Sci. 18: 303 (1922). Syntypes: Transvaal, Pietersburg, *Junod* 4001 (BM!); Belfast, *Wager* 884 (BM!; PRE!); Zimbabwe, Matopos, *Sim* 8862, 8789, 8806 (BM!; PRE!).

Plants small, loosely caespitose, green to yellow-green above, brownish below; terricolous. *Stems* 3–6 mm high, simple; in section round, central strand small, inner cortical cells in 3–4 rows, outer row slightly smaller, weakly thickened. *Leaves* appressed dry, erect-spreading wet; linear-lanceolate, 2,5–3,5 mm long; apex obtuse, weakly cucullate; base scarcely differentiated, oblong; margins broadly incurved or convolute dry, serrulate at apex. *Costa* short-excurrent as yellowish, smooth or denticulate awn, $\frac{1}{5}$–$\frac{1}{3}$ of width of leaf base; in proximal section guide cells 6–10, ventral cells few, over central guide cells, incrassate or substereids, dorsal stereids in small groups separated by larger, incrassate cells, dorsal surface rough; in distal central guide cells, dorsal stereid groups separated by larger incrassate cells, dorsal surface with single incrassate cells projecting below stereid groups. *Upper laminal cells* short-rectangular to rhomboidal, incrassate, smooth; basal cells moderately differentiated, slightly larger, rectangular, thin-walled; alar cells not differentiated.

Sporophytes not known in Southern Africa; described by Mitten as: Perichaetial leaves undifferentiated. *Seta* flexuose; capsule pendulous, buried, small, oval; peristome delicate, incomplete; operculum conic-rostrate; calyptra small, base fimbriate. Fig. 33: 1–8.

Rarely collected in eastern and Southern Africa, *M. perpusillus* is found in woodlands and forests. In the Flora area the species is only found in forests of the northern and eastern Transvaal and southern Natal. Map 44.

Vouchers: *Magill* 3400; *Venter* 4393.

The narrow, weakly convolute leaves, short-excurrent costa and absence of differentiated alar cells should separate *M. perpusillus* from related species. It is somewhat similar to muticous forms of *Campylopus introflexus* and differs from them mainly in the size of plants, the development of the alar cell region of the leaves and the stem anatomy.

6. CAMPYLOPUS

Campylopus *Brid.*, Mant. Musc. 71 (1819); Broth. in Natürl. PflFam. 10: 183 (1924); Sim, Bryo. S. Afr. 165 (1926); Gangulee, Moss. E. India 275 (1971); Scott & Stone, Moss. S. Aust. 137 (1976); Smith, Moss Fl. Brit. Irel. 166 (1978). Lectotype species: *C. flexuosus* (Hedw.) Brid., vide Pfeiffer, Nom. 1: 572 (1853).

Thysanomitrion Schwaegr., Spec. Musc. Suppl. 2: 61 (1823); Broth. in Natürl. PflFam. 10: 188 (1924). Type species: *T. richardii* (Brid.) Schwaegr.

Plants medium to robust, forming tufts, yellowish green to dark green; saxicolous or terricolous. *Stems* erect, occasionally with white or reddish tomentum below; in section central strand present. *Leaves* erect, rigid, narrow; ovate to oblong or elliptical, subulate, channelled to subtubulose above; margins entire to dentate in subula, not bordered. *Costa* broad, occupying at least $\frac{1}{3}$ of leaf base, frequently filling subula, percurrent to excurrent as long, frequently dentate, hyaline awn; in section broad, guide cells numerous, medium-sized, thickened, ventrally with either 1–2 layers of large, thin-walled cells completely covering guide cells or

with a stereid band 1–5 layers thick and generally not covering guide cells, dorsally with small groups of stereids separated by larger incrassate cells or occasionally cells not differentiated, dorsal surface smooth, rough or with lamellae 1–6 cells long below stereid groups. *Laminal cells* quadrate, rectangular or rhomboidal, frequently incrassate; basal cells moderately differentiated, somewhat larger, generally rectangular; alar cells generally differentiated, larger, quadrate to rectangular, hyaline to reddish.

Dioicous. Perigonia gemmiform. Perichaetia terminal, leaves little differentiated. *Seta* cygneous or arcuate; capsule inclined, elliptical, sometimes curved, striate when dry and empty; peristome teeth 16, divided to middle, vertically striate below, orange-brown, papillose above, hyaline; operculum rostrate; calyptra cucullate, fimbriate at base; spores finely papillose.

Approximately 600 species of *Campylopus* are currently recognized. The genus has a world-wide distribution with a concentration of species in tropical and subtropical areas. The major centres of described species are South America and Africa. Forty-six species have been described or reported from the Flora area; only twelve of these are recognized here.

1 Costa in proximal section with well defined ventral stereid or substereid band 1–3 cells thick, occasionally ventral surface cells thin-walled:
2 Leaves 2–3 mm long; dorsal lamellae 2–4 cells long; costa percurrent or short-excurrent as smooth, hyaline awn; frequently long-excurrent in comose leaves, and apical laminal cells hyaline..... 5. *C. simii*
2 Leaves (3–) 4–7 mm long; dorsal lamellae 1(–2) cells long; costa percurrent or excurrent as dentate awn:
3 Leaves long-subulate; margins serrate above; costa percurrent or very short-excurrent, toothed:
4 In proximal section ventral surface cells differentiated, incrassate, occasionally interrupting 2–3 cell thick ventral stereid band; basal leaf cells weakly thickened, rarely pitted.....4. *C. bequaertii*
4 In proximal section costa without differentiated ventral surface cells, ventral stereid band 1(–2) cells thick; basal leaf cells strongly thickened, frequently irregularly so, strongly pitted..... 3. *C. stenopelma*
3 Leaves acuminate; margins entire or toothed at apex; costa short- or long-excurrent as a smooth to dentate, hyaline or yellow awn:
5 Costa wider than ½ width of leaf base; excurrent as a short, generally smooth awn..... 6. *C. subchlorophyllosus*
5 Costa less than ½ width of leaf base; excurrent as short, dentate awn:
6 Plants 40–80 mm high; quadrate basal leaf cells few; apical margins entire; costa excurrent as a hyaline awn, rarely percurrent, in section with well defined stereid bands.....1. *C. ampliretis*
6 Plants 10–30 mm high; quadrate basal leaf cells numerous; apical margins generally serrate; costa excurrent as a yellow awn, in section with substereid bands.....2. *C. delagoae*

1 Costa in proximal section with enlarged ventral cells in single layer, occasionally cells smaller, in 1–2 layers, incrassate:
7 Leaves long-setaceous, 7–12 mm long; dorsal costal surface smooth.....12. *C. procerus*
7 Leaves acuminate to subulate, 2,5–7,0 mm long; dorsal costal surface rough or with lamellae 1–6 cells long:
8 Costa percurrent to short-excurrent, leaf tips occasionally hyaline; in proximal section dorsal costal surface smooth to rough, rarely with projecting cells; in distal section dorsal surface smooth to rough, rarely with lamellae 1–2 cells long:
9 Leaf margins serrate to serrulate above; basal leaf cells not extending further up margin than costa:
10 Alar cells obvious, enlarged, reddish or infrequently hyaline.....7. *C. inchangae*
10 Alar cells indistinct, not strongly differentiated from basal cells, occasionally hyaline and thin-walled.....8. *C. pallidus*
9 Leaf margins entire; basal cells generally hyaline, frequently extending further up margin than costa, forming a weak V-shaped junction of basal and upper laminal cells:
11 In distal section, dorsal costal surface with lamellae 1–2 cells long.....10. *C. introflexus*
11 In distal section, dorsal costal surface rough or with projecting cells.....9. *C. atroluteus*
8 Costa excurrent as short or long, dentate awn; in proximal section dorsal costal surface with projecting cells or single cell lamellae, in distal section dorsal surface lamellae 1–6 cells long:
12 Costa ⅓–⅔ width of leaf base; dorsal costal lamellae 1–2 cells long.....10. *C. introflexus*
12 Costa ½–¾ width of leaf base; dorsal costal lamellae 2–6 cells long.....11. *C. pilifer*

1. **Campylopus ampliretis** (*C. Müll.*) *Par.*, Ind. Bryol. Suppl. 88 (1900); Broth., Natürl. PflFam. 1: 333 (1909). Type: Cape, Montagu Pass, *Rehmann* 60 (PC), per. comm. Frahm; vide Thériot in Dix. & Gepp (1923).

Dicranum ampliretis C. Müll. in Hedwigia 38: 81 (1899).

Dicranum olivaceonigricans C. Müll. in Hedwigia 38: 81 (1899). *Campylopus olivaceonigricans* (C. Müll.) Par., Ind. Bryol. Suppl. 95 (1900). Type: Transvaal, Duivels Krackler, Lydenburg, *Wilms* s.n., 1887 (G, holo.!).

Campylopus edwardsii Sim, Bryo. S. Afr. 168 (1926). Type: Transvaal, Johannesburg, *Edwards* sub *Sim* 9836 (PRE, holo.!).

Thysanomitrion transvaaliense Herz. & Dix. ex Sim, Bryo. S. Afr. 166 (1926). Type: Transvaal, Graskop, *Rolfes* 188 (BM, holo.!, slide only).

Campylopus heteroneurum Thér. in Bull. Soc. bot. Genève 26: 79 (1936). Type: Transvaal, Sanatorium, *Junod* s.n., 1900 (PC).

Plants large or robust, in loose turfs or cushions, yellow-green to dark green above, olive-green to blackish below; saxicolous or rarely terricolous. *Stems* 40–80 mm tall, with sparse, reddish tomentum below; in section round, central strand large, inner cortical cells of medium size, in 4–6 rows, outer cortical cells in 2–3 rows, smaller, stereids to substereids, reddish. *Leaves* frequently comose at apex, and occasionally at intervals along stem indicating previous growth cycles, appressed dry, erect-spreading wet, convolute or occasionally open, lamina frequently weakly undulate; lanceolate to broadly elliptical, narrowly acuminate, 3,5–7,0 mm long; base frequently weakly auriculate; margins entire, broadly incurved above. *Costa* frequently spurred in lamina, $\frac{2}{5}$ width of leaf base, short- to long-excurrent as a dentate, hyaline awn or a very short hyaline tip, rarely percurrent; in proximal section guide cells c. 14, ventral stereid band 1–2 cells thick, central, exposing 1–2 guide cells on either side, dorsal stereid band 2–3 cells thick, occasionally cells substereids, dorsal surface ± smooth; in distal section ventral stereid band 1 cell thick, dorsal stereid band 2–3 cells thick, dorsal surface with single-celled projections (lamellae). *Upper laminal cells* rectangular to rhomboidal, rarely elongate rhomboidal, generally strongly incrassate, pitted; basal cells quadrate to rectangular, in 2–6 rows above alar cells, thin-walled; alar cells moderately to highly differentiated, quadrate, weakly thickened, reddish to dark red.

Sporophytes rare. Perichaetia terminal, leaves slightly larger. *Seta* to 6 mm long, blackish, frequently 2 per perichaetium; capsule elliptical, 2 mm long, plicate dry, blackish; peristome fragile, only basal parts seen; spores round, 20 μm, yellow-brown, granulate. Other parts not seen. Fig. 38: 1–9.

Known from the Azores and Southern Africa, *C. ampliretis* is frequently found on rock in forests or woodlands of the Transvaal and Natal and occasionally in forests of the southern Cape Province. Map 50.

Vouchers: *Arnold* 1271; *Cholnoky* 692, 800, 1079; *Hilliard & Burtt* 10467; *Magill* 3071, 5748, 5943; *Rankin* 132; *Von Breitenbach* 57.

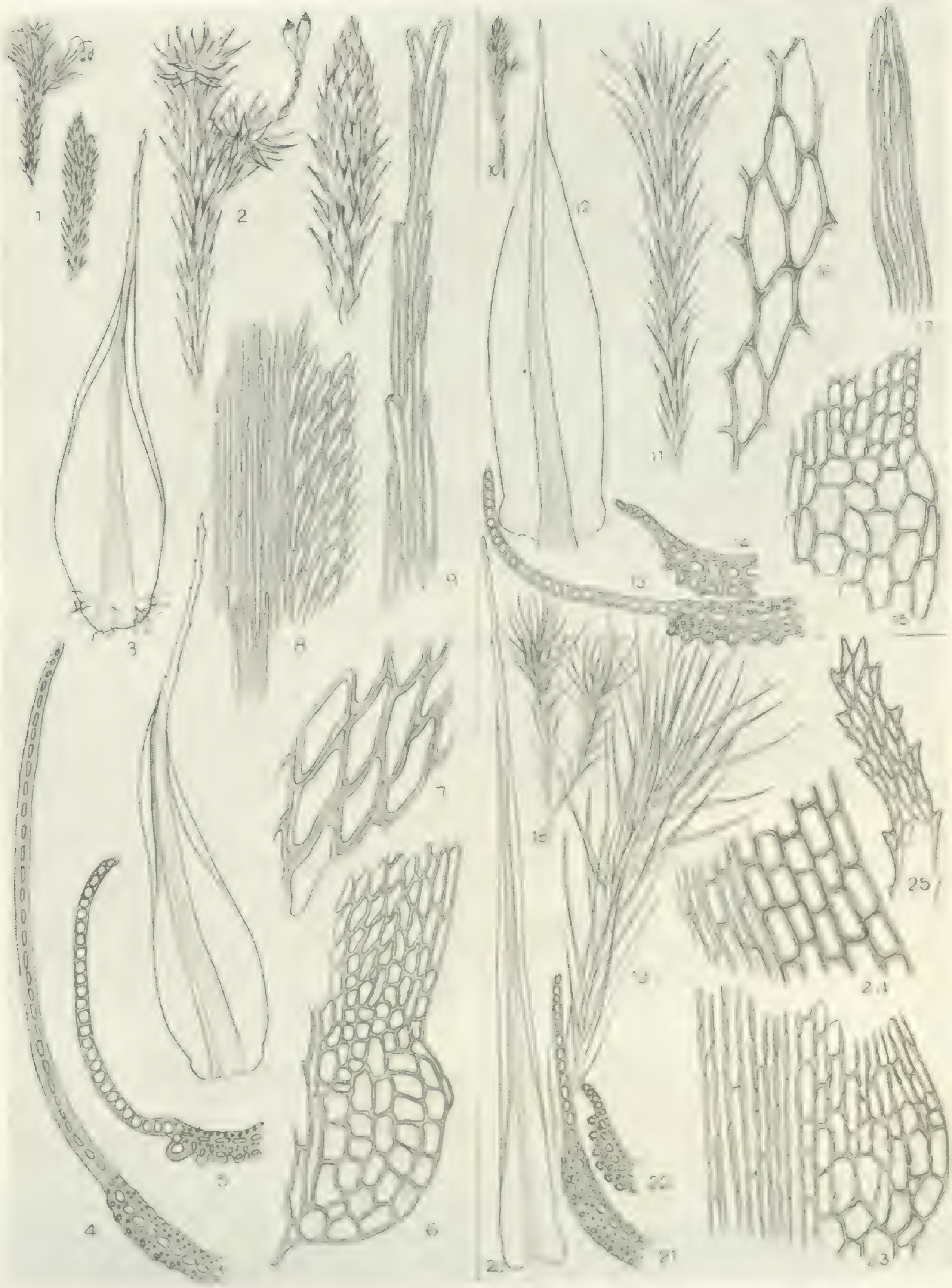
The size of the plants, broad leaves and presence of a ventral stereid band in the costa will separate this species from all other Southern African species except *C. delagoae* (see note under that species).

A considerable degree of variation in the robustness of individual specimens was observed. It was found that this depended entirely on the extent to which the leaves were convolute. Very robust plants have open leaves, while less robust plants have convolute leaves. These differences could not be correlated with any other characters of the plants, leaves or areolation.

2. **Campylopus delagoae** (*C. Müll.*) *Par.*, Ind. Bryol. Suppl. 91 (1900). Type: Transvaal, near Otombi, between Delagoa Bay and Lydenburg, *Wilms* s.n., 1884 (G, holo.!).

Dicranum delagoae C. Müll. in Hedwigia 38: 86 (1899). *Thysanomitrion delagoae* (C. Müll.) Broth. in Natürl. PflFam. 10: 188 (1924).

FIG. 38.—**Campylopus ampliretis** (1–9): **1.** habit, fertile and sterile stems dry, ×1; **2.** habit, fertile and sterile stems wet, ×3; **3.** leaves, ×20; **4.** leaf in proximal cross section (left half), ×170; **5.** leaf in distal section (left half), ×170; **6.** cells at leaf base (right margin), ×170; **7.** upper laminal cells, ×640; **8.** upper juxtacostal cells, ×170; **9.** tip of awn, ×170. **C. delagoae** (10–17): **10.** habit, ×1; **11.** habit, ×3; **12.** leaf, ×20; **13.** leaf in proximal cross section (left half), ×170; **14.** leaf in distal cross section (left half), ×170; **15.** cells at leaf base (right margin), ×170; **16.** upper laminal cells, ×640; **17.** tip of awn, ×170. **C. stenopelma** (18–25): **18.** habit, ×1; **19.** habit, ×3; **20** leaf, ×20; **21.** leaf in proximal cross section (left half), ×170; **22.** leaf in distal cross section. (left half), ×170; **23.** cells at leaf base (right side), ×170; **24.** upper laminal cells, ×640; **25.** tip of subula, ×170. (1–9, *Smook & Phelan* 854; 10–17, *Magill* 4562; 18–25, *Smook & Phelan* 875).



Dicranum inandae C. Müll. in Hedwigia 38: 95 (1899). *Campylopus inandae* (C. Müll.) Par., Ind. Bryol. Suppl. 92 (1900). *Thysanomitrion inandae* (C. Müll.) Broth. in Natürl. PflFam. 10: 189 (1924). Type: Natal, Inanda, *Rehmann* 43 (PRE!).

Plants medium to large, in loose cushions, green to yellow-green above, blackish or brownish below; terricolous or saxicolous. *Stems* 10–30 mm tall, occasionally branched below, with reddish tomentum below; in section round, central strand small to medium, inner cortical cells in 4–6 rows, yellowish, outer cortical cells smaller, in 1–2 rows, stereids to substereids, reddish. *Leaves* crowded, erect-appressed dry, patent wet; oblong to lanceolate, acuminate, 3–5 mm long; base squared; margins entire to serrate at apex, erect to inflexed. *Costa* ⅓ width of leaf base, short-excurrent, to 0,5 mm long, toothed, yellowish; in proximal section guide cells c. 12, ventral substereid band in single layer, central, 2–3 guide cells exposed on both sides, dorsal substereids in groups of 2–3 cells, substereid groups separated by single incrassate cells, dorsal surface with single projecting cell below each stereid group; distal sections with similar anatomy, narrower. *Upper laminal cells* rhomboidal to fusiform, weakly thickened, sinuolate; basal cells quadrate to short-rectangular, weakly thickened, quadrate at basal margins; alar cells short-rectangular, thin-walled, reddish.

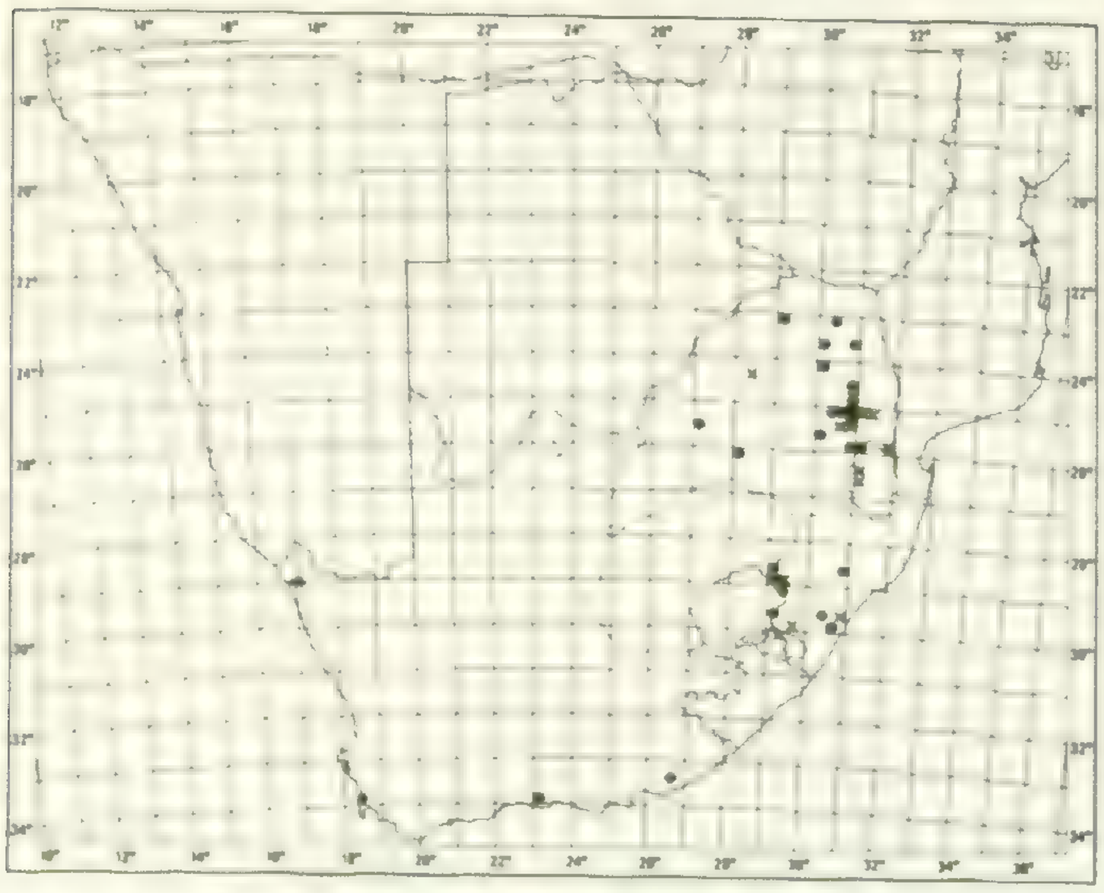
Sporophyte not known. Fig. 38: 10–17.

Campylopus delagoae is known from eastern and Southern Africa. In the Flora area the species is found on rock or soil in forests or woodland of central and eastern Transvaal, Swaziland and Natal. Map 50.

Vouchers: *Cholnoky* 503, 743; *Hardy* 4263; *Magill* 3128, 3647; *Smook* 1460; *Van Vuuren* 1744; *Vorster* 2152.

This species is very similar to *C. ampliretis* in both morphology and Southern African distribution. The two species are provisionally maintained in a local flora context, on the basis of a few apparently consistent character states. In *C. delagoae* the leaf bases are squared and weakly bulging, and there is a distinct region of quadrate basal leaf cells; laminal cells are only weakly thickened and the costa in section contains only substereid bands. On the other hand, the leaf bases in *C. ampliretis* abruptly narrow to the insertion and there are comparatively few quadrate cells in the leaf base; laminal cells are thickened, generally strongly so, and the costa, in section, has well-developed stereid bands.

It is probable that these two species represent forms of a single species, but a broader study, including related species from the rest of Africa, is necessary to properly assess the relationship.



MAP 50.— ● **Campylopus ampliretis**
× **Campylopus delagoae**

3. **Campylopus stenopelma** (*C. Müll.*) *Par.*, Ind. Bryol. Suppl. 97 (1900); Broth. in Natürl. PflFam. 10: 188 (1924); Sim, Bryo. S. Afr. 174 (1926). Syntypes: Cape, Knysna, near Esternek, *Rehmann* 52 (NH!; PRE!); Blanco, *Rehmann* s.n.

Dicranum stenopelma C. Müll. in Hedwigia 38: 83 (1899).

Dicranum chlorotrichus C. Müll. in Hedwigia 38: 87 (1899). *Dicranodontium chlorotrichus* (C. Müll.) Par., Ind. Bryol. Suppl. 119 (1900). *Campylopus chlorotrichus* (C. Müll.) Par., Ind. Bryol. edn 2, 1: 303 (1904); Broth. in Natürl. PflFam. 10: 188 (1924); Sim, Bryo. S. Afr. 172 (1926). Syntypes: Cape, Montagu Pass, *Rehmann* 53 (BOL!; NH!; PRE!); Knysna, *Rehmann* 53b (NH!; PRE!); Blanco, *Rehmann* s.n.

Dicranum perfalcatum C. Müll. in Hedwigia 38: 87 (1899). *Dicranodontium perfalcatum* (C. Müll.) Par., Ind. Bryol. Suppl. 119 (1900). *Campylopus capensis* Broth. in Natürl. PflFam. 10: 188 (1924), non *Campylopus perfalcatus* Broth. (1901). Type: Cape, Knysna, near Esternek, *Rehmann* s.n., 1875 (BM!; PC!).

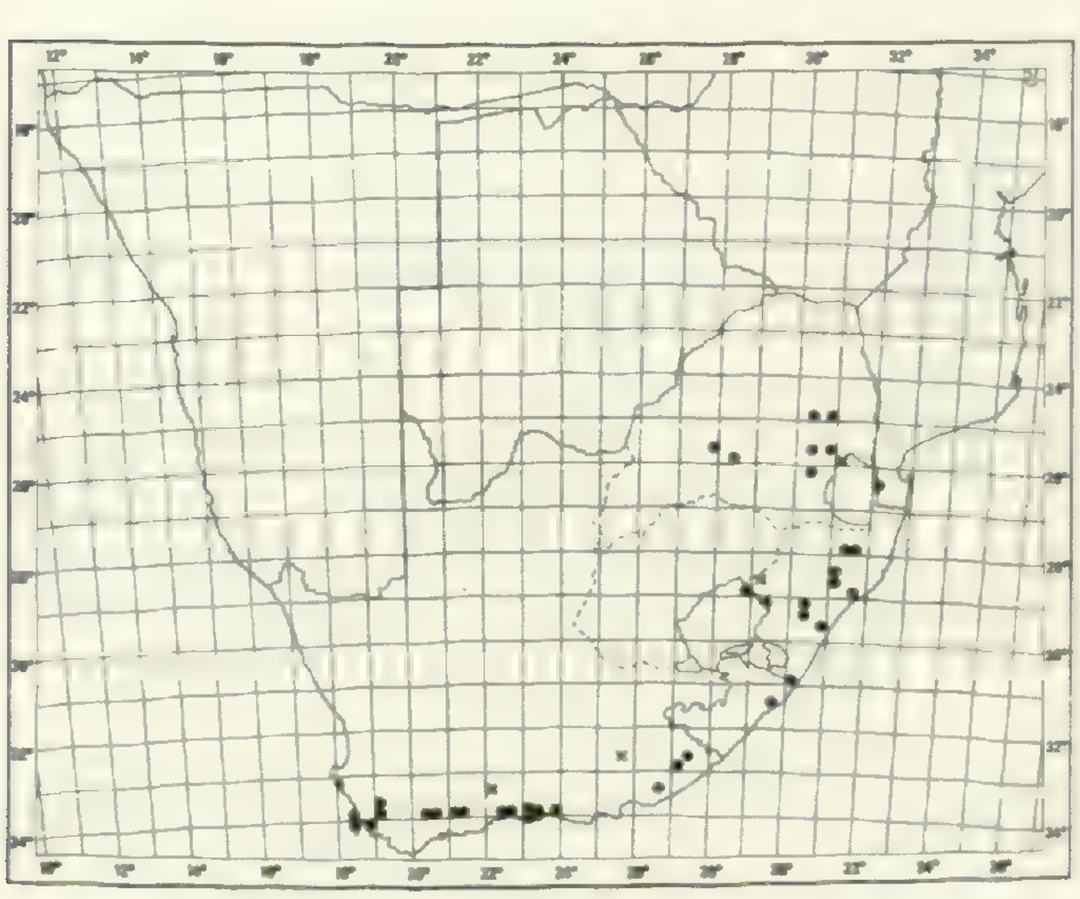
Dicranum tenax C. Müll. in Hedwigia 38: 83 (1899). *Campylopus tenax* (C. Müll.) Broth. in Natürl. PflFam. 10: 188 (1924). Type Cape, Blanco, *Rehmann* 54 (BOL!; NH!; PRE!).

Plants medium to large, in loose cushions, yellow-green; terricolous or corticolous. *Stems* 10–25 mm tall, infrequently branched, mainly below, lower stem covered with reddish tomentum; in section subround to elliptical, central strand small or large, inner cortical cells in 4–6 rows, medium-sized, incrassate, yellowish, outer cortical cells substereids, in 2–4 rows, smaller, reddish. *Leaves* crowded frequently falcate,

erect to contorted dry, erect-spreading wet, linear-lanceolate, subulate, 4–7 mm long; base subauriculate; margins erect to incurved, entire below, serrate in upper subula. *Costa* ⅓ of width of leaf base, percurrent; in proximal section guide cells 14–20, ventral stereid band small, in single layer, centred, exposing 3–4 guide cells on either side, dorsal stereids in small groups, 2–3 cells each, stereid groups separated by larger, incrassate cells; in distal section ventral stereid band 1 layer thick, centred, exposing 1–2 guide cells on either side, dorsal cells incrassate or substereids, dorsal surface with single cell lamellae. *Upper laminal cells* rounded, quadrate to short-rectangular or rhomboidal, thickened, unpitted; basal cells rectangular, strongly thickened, sometimes irregularly so, almost smooth to strongly pitted; alar cells enlarged, quadrate, thin-walled, hyaline to reddish.

Sporophyte not seen. Fig. 38: 18–25.

Endemic to Southern Africa, *C. stenopelma* is fairly widespread in woodland or forests. The species is known from the central and eastern Transvaal, Swaziland, Zululand, Natal, Lesotho, Transkei, and the eastern, southern and southwestern Cape. Map 51.



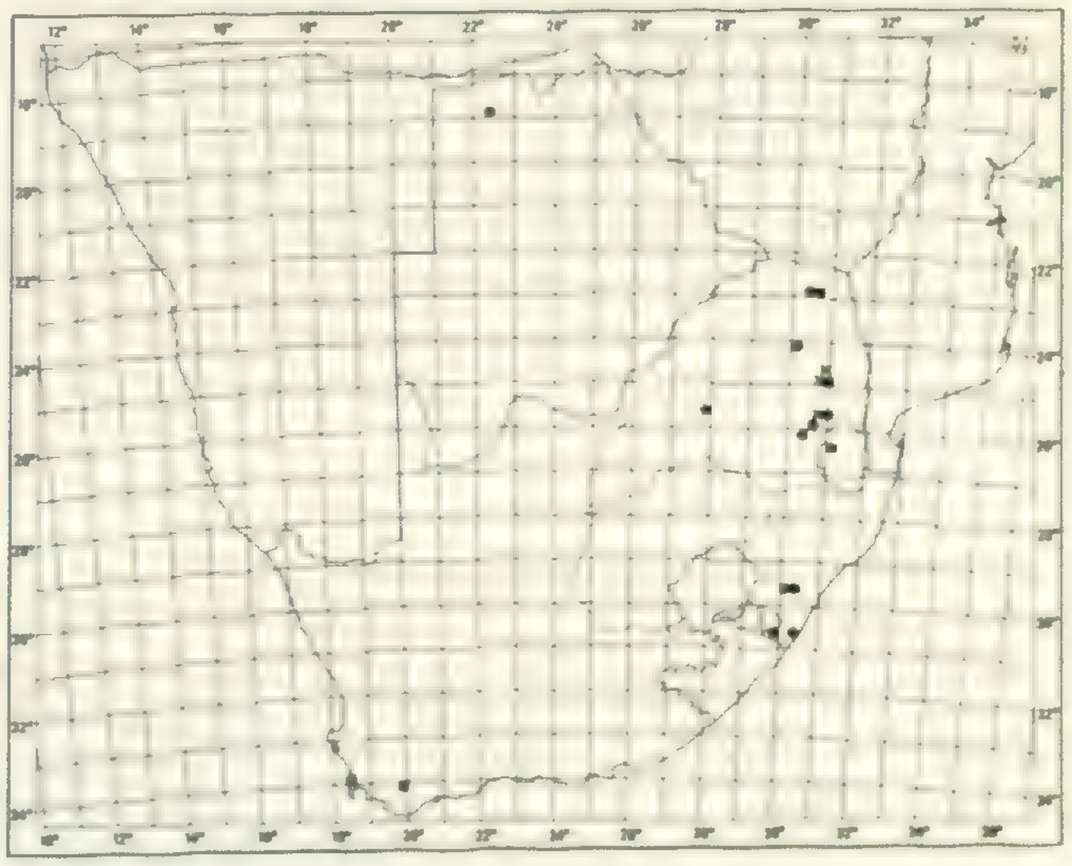
MAP 51.— ● **Campylopus stenopelma**
× **Campylopus subchlorophyllosus**

Vouchers: *Cholnoky* 679, 1090; *Magill* 3549, 6162; *Oliver* 7062; *Smook* 880.

The long, narrow, serrate leaves of this species could be mistaken for those of similar species, such as *C. inchangae* or *C. stramineus*. The presence of a small ventral stereid band in the costa of the long, narrow leaves will separate *C. stenopelma* from all other Southern African species of *Campylopus* except *C. bequaertii*. The latter two species are also easily separated on the basis of costal anatomy.

4. **Campylopus bequaertii** *Thér. & Nav.* in Bull. Soc. r. Bot. Belg. 60: 17 (1927); Richards & Clear in Trans. Br. bryol. Soc. 5: 309 (1967). Type: Zaire, Ruwenzori, Butagu, *Bequaert* 4974 (PC, holo.).

Plants medium to large, loosely caespitose, green to yellow-green, blackish below; terricolous. *Stems* 20–30 mm tall, branching mainly above, with sparse, reddish tomentum; in section round, central strand of medium size, inner cortical cells in 5–6 rows, of medium size, thin-walled, outer cortical cells in 2–4 rows, thickened, red-brown. Leaves widespreading, twisted dry, spreading wet, linear-lanceolate, subulate, 4,5–8,0 mm long; base weakly auriculate; margins erect, serrate in subula. *Costa* ⅔ of width of leaf base, short-excurrent as toothed awn; in proximal section guide cells c. 18, ventral stereid band strong, 2–3 cells thick, completely covering guide cells, ventral surface cells in single layer across costa, incrassate, occasionally interrupting stereid band, dorsal stereid groups of 2–4 cells separated by larger, thin-walled, triangular cells, dorsal surface with a single, thin-walled cell projecting below each stereid group; in distal section costa narrower, anatomy otherwise similar. *Upper laminal cells* quadrate to short-rectangular, weakly thickened; basal cells larger, rectangular to short-rectangular, weakly thickened, not pitted; alar cells in large distinct group, rectangular, thin-walled, hyaline to reddish.



MAP 52.— ● **Campylopus bequaertii**
× **Campylopus procerus**

Sporophyte not known in Southern Africa. Fig. 39: 1–8.

Campylopus bequaertii is known from western, central and Southern Africa. In Southern Africa, the species is known from Botswana, the northern, central and eastern Transvaal, Swaziland, Natal and the southwestern Cape. Map 52.

Vouchers: *Cholnoky* 746; *Magill* 3425, 4732; *Rankin* 88.

The Southern African plants are more uniform and perhaps distinct from the rather variable western and central African element (Richards & Clear, 1967; Bizot & Kilbertus, 1979). Specimens from the Flora area are therefore only tentatively placed under this species.

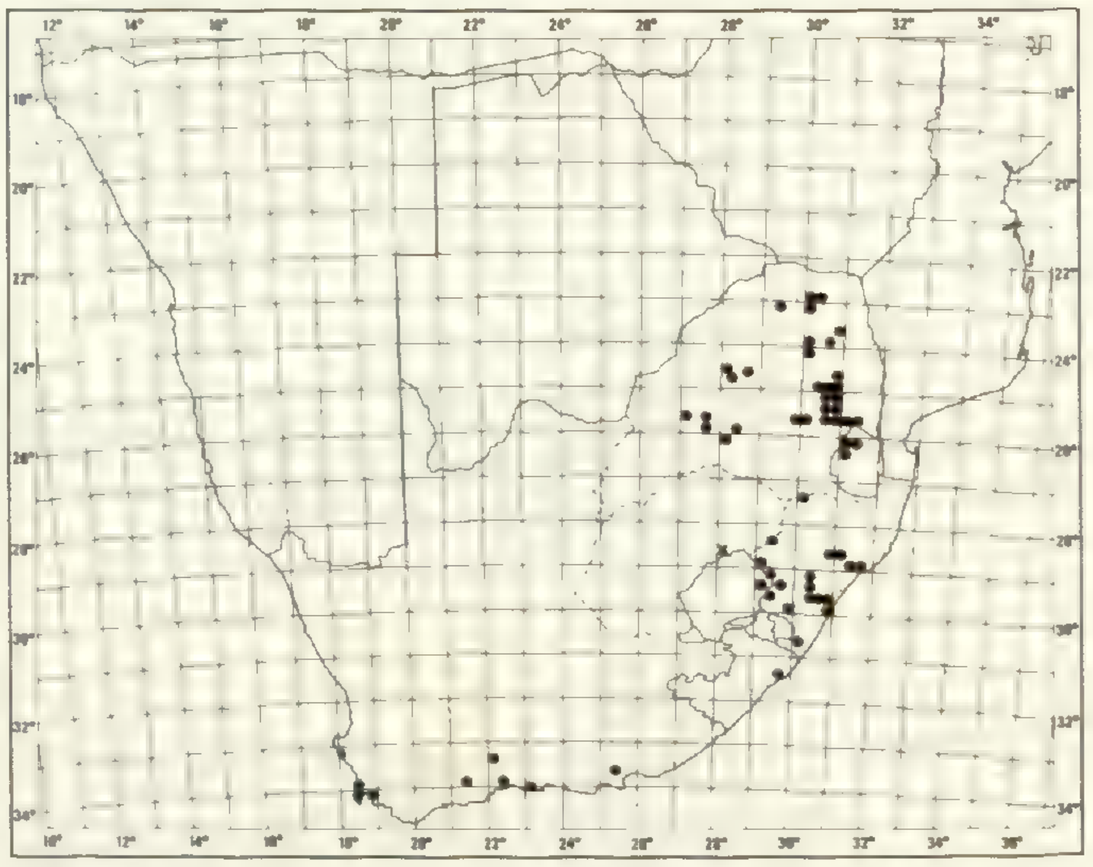
5. **Campylopus simii** *Schelpe* in Mem. bot. Surv. S. Afr. 43: 5 (1979). Type: Orange Free State, Kadziberg, *Rehmann* 58 (PRE, holo.!).

Campylopus pseudojulaceus Sim, hom. illeg., Bryo. S. Afr. 169 (1926), non C. Müll. (1898).

Plants small to medium, yellow-green; terricolous. *Stems* 10–15 mm tall, occasionally branched; in section round, central strand large, inner cortical cells large, in 2–3 rows, thin-walled, outer cortical cells small, in 1–4 rows, stereids to substereids. *Leaves* julaceous, occasionally comose, appressed dry, erect wet, oblong to elliptical, short-acuminate, 2,0–2,5 mm long; apex blunt, chlorophyllose; margins entire, incurved above, plane below; comose leaves ovate to ligulate, 3 mm long; apex acuminate, hyaline. *Costa* $\frac{4}{5}$ of width of leaf base, percurrent, filling acumen or occasionally very short-excurrent as hyaline awn, in comose leaves long excurrent as hyaline awn; in proximal section guide cells c. 24, ventral stereid band in 1(–2) row(s), sometimes substereids, centred, exposing 3–5 guide cells on either side, dorsal stereid cells in small groups of 3–4 cells each, stereid groups separated by larger, thickened cells, dorsal surface with lamellae below stereid groups, lamellae 2–4 cells long, distal cells incrassate; in distal section costa narrower, anatomy similar. *Upper laminal cells* fusiform, thickened; basal cells highly differentiated, rectangular to linear, thin-walled, hyaline, extending further up margin than costa, forming distinct V-shaped junction with laminal cells; alar cells weakly developed, quadrate, thin-walled, hyaline to reddish.

Sporophytes not known. Fig. 39: 9–16.

Endemic to Southern Africa, *C. simii* is presently known only from rock at high altitude in the eastern Orange Free State. Map 53.



MAP 53.— ● **Campylopus inchangae**
× **Campylopus simii**

Voucher: Type only.

The presence of a ventral stereid band in the costa and long dorsal lamellae will separate *C. simii* from the other Southern African species. The type specimen is also distinct by the presence of comose tufts of leaves with differentiated hyaline apices.

6. **Campylopus subchlorophyllosus** *C. Müll. ex Rabenh.*, Bryoth. Eur. 28: n. 1362 (1884). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n. (BM!; GRA!).

FIG. 39.—**Campylopus bequaertii** (1–8): **1.** habit, ×1; **2.** habit, ×3; **3.** leaf, ×20; **4.** leaf in proximal cross section (left half), ×170; **5.** leaf in distal cross section (left half), ×170; **6.** cells at leaf base (left margin), ×170; **7.** upper laminal cells, ×640; **8.** tip of subula, ×170. **C. simii** (9–16): **9.** habit, ×1; **10.** habit, ×3; **11.** leaf, ×20; **12.** leaf in median cross section (left half), ×170; **13.** cells at leaf base (right side), ×170; **14.** upper laminal cells, ×640; **15.** leaf apex, ×170; **16.** leaf from comose head, ×20. **C. subchlorophyllosus** (17–24): **17.** habit, ×1; **18.** habit, ×3; **19.** leaves, ×20: **20.** leaf in proximal cross section, ×170; **21.** leaf in distal cross section, ×170; **22.** cells at leaf base (right side), ×170; **23.** upper laminal cells, ×640; **24.** leaf apex, ×170. **C. pallidus** (25–32): **25.** habit, ×1; **26.** habit, ×5; **27.** leaves, ×20; **28.** leaf in proximal cross section, ×170; **29.** leaf in distal cross section, ×170; **30.** cells at leaf base (right side), ×170; **31.** upper laminal cells, ×640; **32.** leaf apex, ×170. (1–8, *Magill* 4732; 9–16, *Rehmann* 58, 17–24, *Cholnoky* 1004; 25–32, *Haggarth* 4).

Dicranum basalticolus C. Müll. in Hedwigia 38: 82 (1899). *Campylopus basalticolus* (C. Müll.) Par., Ind. Bryol. Suppl. 89 (1900); Broth. in Natürl. PflFam. 10: 187 (1924). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1878 (BM!).

Plants small to medium, in loose cushions, yellow-green, brownish below; terricolous. *Stems* 5–15 mm tall, little branched; in section round, central strand of medium size, inner cortical cells in 4 rows, thin-walled, outer cortical cells stereids or substereids, in 1 row, reddish. *Leaves* crowded, appressed dry, erect-spreading wet; oblong to elliptical, acuminate, 3–4 mm long; base not differentiated; margins entire, broadly incurved. *Costa* $\frac{3}{5}$–$\frac{3}{4}$ of width of leaf base, percurrent to excurrent as short, smooth or dentate, hyaline awn; in proximal section guide cells c. 24, small, thickened; ventral stereid band 1–2 cells thick, completely covering guide cells, dorsal stereids in small groups of 2–3 cells each, stereid groups separated by large, incrassate cells, dorsal surface with a single projecting cell below each stereid group; in distal section ventral stereid band 1–2 cells thick, central, exposing 3–4 guide cells on either side, dorsal stereid groups smaller, of 1–2 cells each, separated by large, incrassate cells, dorsal surface with single-celled lamellae below each stereid group, outer walls strongly thickened. *Upper laminal cells* rounded, quadrate to short-rectangular, incrassate; basal cells elongate, irregularly shaped, elliptical to rectangular or triangular, thickened, not pitted; alar cells not strongly differentiated, quadrate, thin-walled, reddish.

Sporophyte not known. Fig. 39: 17–24.

Endemic to Southern Africa, *C. subchlorophyllosus* is rarely collected on soil in fynbos or grasslands of the southern and central Cape, western Natal and eastern Transvaal. Map 51.

Vouchers: *Cholnoky* 725, 1004; *Smook* 1410.

Although *C. subchlorophyllosus* is not a very distinctive species, it does not appear to be closely related to any other Southern African species. It is identified by the presence of a small ventral stereid band in the costa, short, narrow leaves, and dorsal lamellae consisting of single projecting cells.

7. **Campylopus inchangae** (*C. Müll.*) *Par.*, Ind. Bryol. Suppl. 92 (1900); Dix. in Trans. R. Soc. S. Afr. 8: 185 (1920); Broth. in Natürl. PflFam. 10: 186 (1924). Type: Natal, Inchanga, *Rehmann* 42 (BM!; PC!).

Dicranum inerangae C. Müll., in Hedwigia 38: 83 (1899) orth. var.; *Campylopus imerangae* (C. Müll.) Par., Ind. Bryol. Suppl. 92 (1900), orth. var., vide Dixon (1920).

Dicranum altovirescens C. Müll. in Hedwigia 38: 152 (1899). *Campylopus altovirescens* (C. Müll.) Par., Ind. Bryol. Suppl. 88 (1900); Broth. in Natürl. PflFam. 10: 186 (1924). Type: Natal, Jammerlappen, *Dittrich* s.n., 1897 (H-BR!).

Dicranum longescens C. Müll. in Hedwigia 38: 85 (1899); *Campylopus longescens* (C. Müll.) Par., Ind. Bryol. Suppl. 94 (1900); Broth. in Natürl. PflFam. 10: 186 (1924). Type: Cape, Knysna, Esternek, *Rehmann* 41 (NH!; PRE!).

Dicranum nanotenax C. Müll. in Hedwigia 38: 82 (1889). *Campylopus nanotenax* (C. Müll.) Par., Ind. Bryol. Suppl. 94 (1900); Broth. in Natürl. PflFam. 10: 186 (1924). Syntypes: Natal, Mapumulo, *Borgen* s.n., 1867; Van Reenens Pass, *Rehmann* 51 (BM!; G!).

Dicranum serridorsus C. Müll. in Hedwigia 38: 84 (1899). *Campylopus serridorsus* (C. Müll.) Par., Ind. Bryol. Suppl. 97 (1900); Broth. in Natürl. PflFam. 10: 185 (1924). Type: Cape, Table Mountain, *Rehmann* 45 (PRE!).

Dicranodontium laxitextum Broth. & Bryhn in Forh. Vidensk Selsk. Krist. 1911 (4): 7 (1911). *Campylopus bryhnii* Broth. in Natürl. PflFam. 10: 188 (1924). Type: Natal, Zululand, Ekombe, *Titlestad* s.n., 1907 (H-BR, holo.!; PC!).

Plants medium to large, in cushions, green to yellow-green; terricolous or saxicolous. *Stems* 10–40 mm tall, frequently with reddish tomentum below; in section round, central strand small, inner cortical cells in 5–6 rows, of medium size, outer cortical cells in 2–3 rows, smaller, reddish. *Leaves* weakly contorted dry, spreading wet, linear-lanceolate, subulate to setaceous, 4–7 mm long; base auriculate; margins plane to erect, serrate to serrulate above. *Costa* $\frac{1}{3}$–$\frac{2}{5}$ of width of leaf base, percurrent; in proximal section guide cells c. 22, ventral cells large, thin-walled, completely covering guide cells, dorsal stereids in groups of 4–8 cells, stereid groups separated by larger, strongly incrassate cells, dorsal surface smooth to rough; in distal section ventral cells incrassate, completely covering guide cells, dorsal stereid groups of 4 cells separated by a larger incrassate cell, dorsal surface with single-celled lamellae under stereid groups. *Upper laminal cells* small, quadrate to rhomboidal or rectangular, incrassate; basal cells larger, rectangular, incrassate, occasionally weakly pitted; alar cells generally well defined, quadrate, enlarged, reddish.

Perichaetia terminal, leaves oblong, subulate to setaceous, 8–9 mm long. *Seta* 6–7 mm long, flexuose to cygneous, red-brown; capsule arcuate, urn cylindrical, 1,5–2,0 mm long; exothecial cells rectangular, incrassate; peristome teeth 16, triangular, 0,5 mm long, cleft above, striate below, papillose above, reddish; operculum rostrate; spores round, 12–15 μm, irregularly papillose. Fig. 40: 14–21.

Campylopus inchangae is known from eastern and Southern Africa. In the Flora area the species is infrequently collected on soil or rock and occasionally at the base of trees in grassland and woodland of Transvaal, Swaziland, Zululand, Natal, Lesotho, Transkei and the southern and southwestern Cape. Map 53.

Vouchers: *Cholnoky* 243; *Magill* 3528, 4791, 4899, 5091, 6139; *Rankin* 284; *Schelpe* 7578.

Campylopus inchangae is most similar in general appearance to *C. stenopelma* or *C. bequaertii*, but lacks the stereid cells in the ventral costa. The ventral costal cells of *C. inchangae* are large and thin-walled in section and together with the small leaf cells and long, narrow, serrate leaves, will help to place specimens.

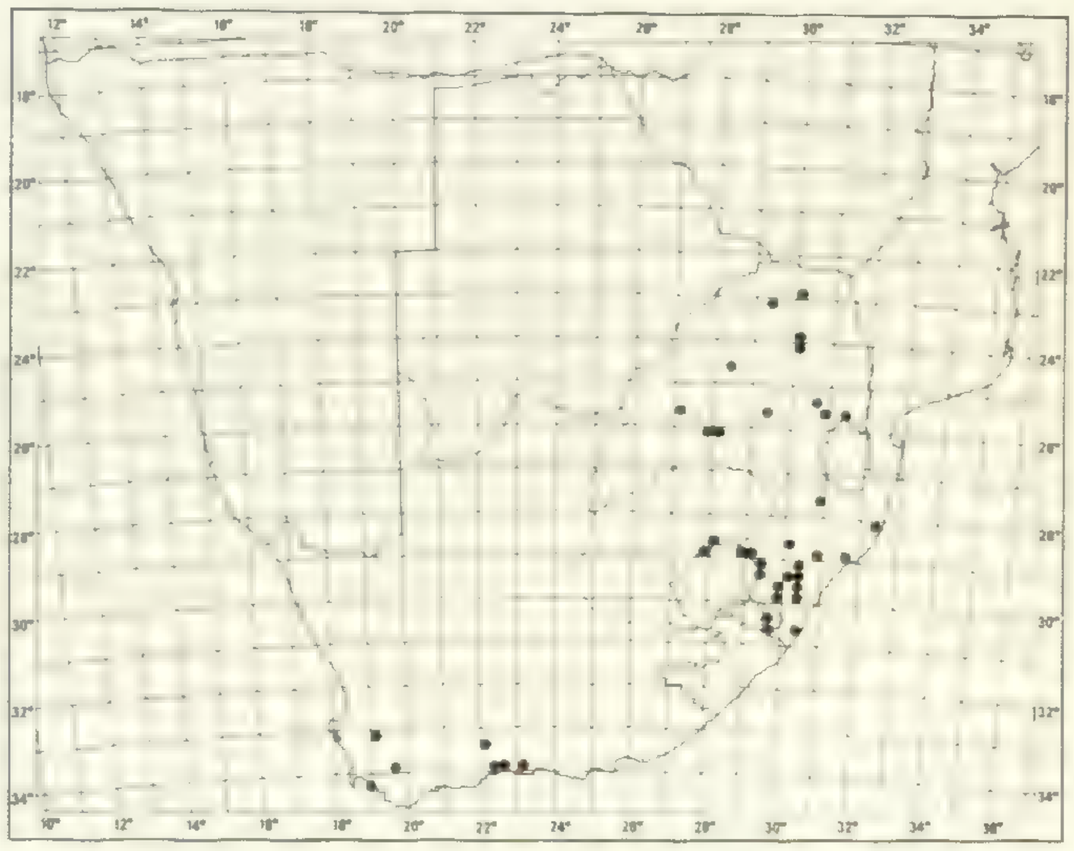
8. **Campylopus pallidus** *Hook. f. & Wils.* in Hook. f., Fl. Nov. Zel. 2: 68 (1854); Scott & Stone, Moss. S. Aust. 142 (1976). Syntypes: New Zealand, North Island, East Coast and Auckland, *Colenso* s.n., *Sinclair* s.n.

Dicranum pulvinatus C. Müll. in Hedwigia 38: 80 (1899), hom. illeg. *Campylopus pulvinatus* (C. Müll.) Par., Ind. Bryol. Suppl. 96 (1900); Sim, Bryo. S. Afr. 179 (1926), hom. illeg. Type: Cape, Stinkwater, *Rehmann* 62 (PRE!).

Plants of medium size, forming cushions, yellow-green to light green; terricolous or saxicolous. *Stems* 2–15 mm high, branching mainly above, with reddish tomentum below; in section round, central strand small, cells collapsed, inner cortical cells in 3–4 rows, thin-walled, outer cortical cells in 2–3 rows, incrassate, reddish. *Leaves* crowded, tips weakly contorted dry, erect-spreading wet; linear-lanceolate to ovate-subulate, 2,5–6,0 mm long, broadly channelled ventrally; margins broadly incurved, entire to serrulate. *Costa* $\frac{1}{3}$–$\frac{1}{2}$ of width of leaf base, percurrent or excurrent as short, denticulate tip; in proximal section guide cells c. 18, ventral cells large, completely covering guide cells, dorsal stereids in groups of 4 to 15 cells, stereid groups separated by larger incrassate cells or occasionally cells undifferentiated and uniformely incrassate, dorsal surface cells often larger, incrassate, dorsal surface rough; in distal section ventral cells incrassate, completely covering guide cells, dorsal cells incrassate or stereids, dorsal surface with projecting cells or single-celled lamellae. *Upper laminal cells* quadrate to rhomboidal, incrassate; basal cells rectangular, thin-walled, hyaline to yellowish; alar cells not differentiated to weakly bulging, rectangular, thin-walled, hyaline to yellowish or rarely reddish.

Perichaetia terminal, leaves undifferentiated. *Seta* 10–12 mm long, yellowish; capsule cylindrical, 0,8–1,2 mm long, plicate dry; exothecial cells rectangular, sinuate, incrassate; peristome teeth 16, triangular, cleft above, 0,3–0,4 mm long, striate below, papillose and hyaline above; operculum rostrate; calyptra cucullate, 1,5 mm long; spores round, 13–15 μm, pale yellow, granulate. Fig. 39: 25–32.

Widespread in the Southern Hemisphere, *C. pallidus* has only recently been recognized from Southern Africa. In the Flora area the species is most commonly collected in Natal; however, specimens are frequently collected in the montane grasslands or forests of Transvaal, eastern Orange Free State, Lesotho, Zululand and the southern and southwestern Cape. Map 54.



MAP 54.— ● **Campylopus pallidus**

Vouchers: *Magill* 5071, 5732; *Oliver* 7355; *Van Rooy* 457; *Von Breitenbach* 270.

The species is related to *C. inchangae*; the two species differ primarily in the development of alar cells and the dentation of the subula of the leaves. *Campylopus pallidus* is also similar to some facies of *C. atroluteus* from which it is most easily separated

by: (1) quadrate laminal cells that extend nearly to the apex, (2) weakly serrulate margins of the subula, and (3) basal cells not or only rarely extending higher up the margin than the costa, a condition that is common in *C. atroluteus* in Southern Africa.

9. **Campylopus atroluteus** (*C. Müll.*) *Par.*, Ind. Bryol. Suppl. 89 (1900); Broth. in Natürl. PflFam. 10: 187 (1924); Sim, Bryo. S. Afr. 178 (1926). Syntypes; Cape, Stinkwater, *Rehmann* 44 (NH!); Cape Town, *Rehmann* 63 (BOL!; NH!; PRE!).

Dicranum atroluteus C. Müll. in Hedwigia 38: 80 (1899).

Dicranum bartramiaceus C. Müll. in Hedwigia 38: 86 (1899). *Campylopus bartramiaceus* (C. Müll.) Thér. ex Broth. in Natürl. PflFam. 10: 185 (1924). Type: Cape, Cape Town, *Rehmann* 37 (PRE!).

Dicranum catarractilis C. Müll. in Hedwigia 38: 79 (1899). *Campylopus catarractilis* (C. Müll.) Par., Ind. Bryol. Suppl. 90 (1900); Broth. in Natürl. PflFam. 10: 187 (1924); Sim, Bryo. S. Afr. 179 (1926). Type: Cape, Devil's Peak, *Rehmann* 64 (PRE!).

Dicranum leptotrichaceus C. Müll. in Hedwigia 38: 84 (1899). *Campylopus leptotrichaceus* (C. Müll.) Par., Ind. Bryol. Suppl. 93 (1900); Broth. in Natürl. PflFam. 10: 185 (1924); Sim, Bryo. S. Afr. 172 (1926). Type: Cape, Knysna, Esternek, *Rehmann* s.n., 1875 (BM!).

Dicranum ampliretis C. Müll. in Hedwigia 38: 81 (1899). Type: Cape, Montagu Pass, *Rehmann* 60 (quoad specimen herb. BM!).

Plants of medium size, loosely caespitose, yellow-green, brownish below; terricolous. *Stems* 10–20 mm high, with sparse, reddish tomentum below; in section round, central strand large, inner cortical cells in 3–4 rows, thin-walled, outer cortical cells in 2 rows, smaller, thickened, reddish. *Leaves* weakly contorted dry, erect-spreading wet; ovate-lanceolate to elliptical, subulate, 4–6 mm long; apex occasionally with hyaline tip; base scarcely differentiated; margins entire, inrolled above. *Costa* $\frac{3}{5}$ of width of leaf base, percurrent or short-excurrent, yellow to hyaline; in proximal section guide cells c. 20, ventral cells large, thin-walled or occasionally incrassate, dorsal cells undifferentiated, incrassate or strongly differentiated medianally, with small groups of stereids separated by larger, incrassate cells, laterally without stereid groups, all cells large, forming multistratose area 1–8 cells wide, dorsal surface smooth to rough; in distal section costa frequently occupying entire leaf, ventral cells smaller, incrassate, completely covering guide cells, dorsal cells frequently undifferentiated, stereids or substereids, dorsal surface rough or with single-celled projections. *Upper laminal cells* quadrate to rectangular or elongate, sinuolate, incrassate; basal cells frequently reaching higher along margins than costa, narrowly rectangular, thin-walled; alar cells scarcely differentiated, occasionally reddish.

Sporophyte not known in Southern Africa. Fig. 40: 1–13.

Found throughout Africa and the West African Islands, *C. atroluteus* is generally collected on soil in grassland and woodland. In Southern Africa the species is frequently collected in the southern and southwestern Cape, Natal, Lesotho, Zululand, eastern Orange Free State, Swaziland, and Transvaal. A few specimens have also been collected in the eastern Cape and the Caprivi Strip of South West Africa/Namibia. Map 55.

Vouchers: *Cholnoky* 278, 380; *Emdon* 3; *Magill* 5791, 5803, 6344; *Smook* 829; *Van Rooy* 573.

An unusually complex species, *C. atroluteus* is made up of several entities that could not be satisfactorily separated, except at the extremes of each group. Therefore a rather broad species concept is accepted here (see also Frahm, 1976) encompassing a large amount of variation between individual specimens. The variation is most frequently expressed in leaf size and shape, apex shape and anatomy of the costa.

FIG. 40.—**Campylopus atroluteus** (1–13): **1.** habit, ×1; **2.** habit, ×1; **3.** habit, ×1; **4.** habit, ×2; **5.** leaves, ×20; **6.** leaf in proximal cross section (left half, typical form), ×170; **7.** leaf in proximal cross section (left half, intermediate form), ×170; **8.** leaf in proximal cross section (right half, 'bartramiaceus' facies), ×170; **9.** leaf in distal cross section (right half, typical form). ×170; **10.** cells at leaf base (right side), ×170; **11.** junction of basal and laminal cells, ×170; **12.** upper laminal cells, ×640; **13.** leaf apex, ×170. **C. inchangae** (14–21): **14.** habit, ×1; **15.** habit, ×2; **16.** leaf, ×20; **17.** leaf in proximal cross section (left half), ×170; **18.** leaf in distal section (left half), ×170; **19.** cells at leaf base (left margin), ×170; **20.** tip of subula, ×170; **21.** laminal cells in upper subula, ×435. **C. procerus** (22–33): **22.** habit, ×1; **23.** leaf, ×20; **24.** leaf in proximal cross section (left half), ×170; **25.** leaf in distal cross section (left half), ×170; **26.** cells at base of leaf (left margin), ×170; **27.** upper laminal cells, ×170; **28.** tip of subula, ×170; **29.** calyptra, ×20; **30.** capsule, ×5; **31.** deoperculate capsule and calyptra, ×5; **32.** part of capsule mouth with peristome tooth, ×90; **33.** enlargement of peristome tooth, ×640, (1, *Vorster* 448*a*; 2 & 7, *Lavranos* 15297*a*; 3–6 & 9–13, *Cholnoky* 919; 8, *Rehmann* 37; 14–21, *Rehmann* 42; 22–33, *Wager* 209).

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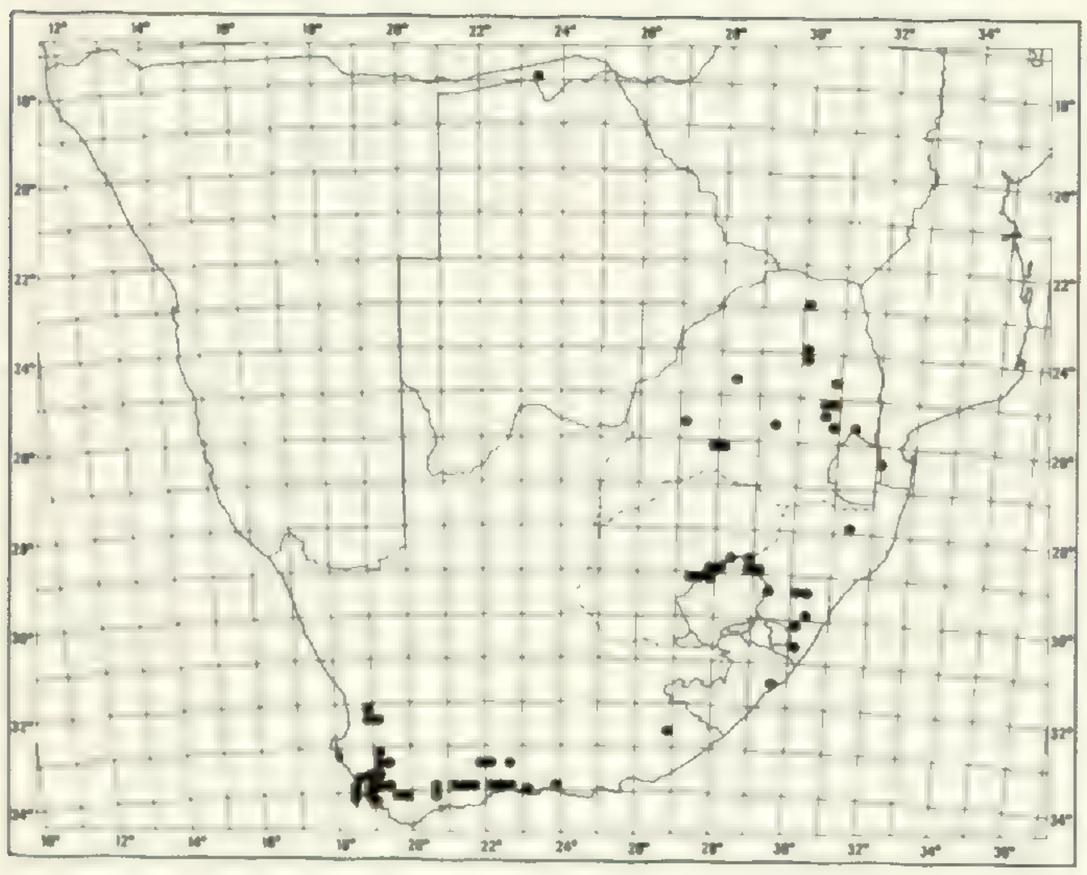


MAP 55.— ● **Campylopus atroluteus**

One of the most interesting variations is expressed in the costal anatomy of facies *bartramiaceus*. Small dorsal stereid groups are present in the central part of the costa, but laterally the cells are undifferentiated. The cells are similar in size and shape to the ventral cells, thus giving the leaves a multistratose appearance up to 8 cells wide on either side. A similar development, although involving only 1–3 rows of cells, has been seen in other specimens of *C. atroluteus* and occasionally in *C. inchangae* and *C. introflexus*.

The South African specimens referred to *C. bicolor* (C. Müll.) Wils. (Sim, 1926; Dixon, 1920; Frahm, pers. comm.) differ in leaf shape and costal anatomy from the Australian and New Zealand specimens that have been examined. These specimens (*Hall* 4, 5, 6, BM!; *Van Zanten* 7608198, PRE!) are therefore provisionally treated as a facies of the species complex treated here as *C. atroluteus*. The Southern African specimens, that have been referred to *C. bicolor*, have leaves that are narrowly subulate above an oval or ovate base. The leaf apices are frequently narrow and cucullate, although occasionally some leaves have straight apices or even short, hyaline tips. The leaves of the isosyntypes of *C. atroluteus* have a similar shape and most apices are straight with short, hyaline tips. A few of the leaves, however, have narrow, cucullate apices. Another specimen (*Garside* 6283) with a slightly longer, denticulate, hyaline point, has recently been referred to *C. bicolor* var. *ericeticola* (C. Müll.) Dix. (pers. comm. Frahm, 1980).

Dixon (1920) went into the subject of variation in leaf apices of this group in some detail, when he recorded *C. bicolor* from Southern Africa. He also suggested a possible relationship to *C. pseudobicolor*. The relationship of this Malagasy species and Southern African species must still be explored.

In view of the plasticity of this 'species' as well as its facies that occasionally resemble forms of *C. introflexus* or *C. pallidus*, and its apparent relationship to *C. bicolor*, the above specimens are provisionally treated under the species complex *C. atroluteus*. The problem of further separation of this complex into recognizable taxa, whether at the specific or subspecific level, will only be solved when the problem is examined on a much broader scale.

10. **Campylopus introflexus** (*Hedw.*) *Brid.*, Mant. Musc. 72 (1819); Broth. in Natürl. PflFam. 10: 187 (1924); Sim, Bryo. S. Afr. 170 (1926); Gangulee, Moss. E. India 300 (1971); Scott & Stone, Moss. S. Aust. 140 (1976); Smith, Moss F1. Brit. Irel. 183 (1978). Type: Nova Hollandia.

Dicranum introflexum Hedw., Spec. Musc. 147 (1801).

Dicranum lepidophyllus C. Müll., Syn. Musc. 1: 407 (1848). *Campylopus lepidophyllus* (C. Müll.) Jaeg., Adumbratio 1: 139 (1872); Sim, Bryo. S. Afr. 171 (1926). Syntypes: Cape, Palmiet River, *Ecklon* s.n. (BM!); Caledon, Gnetpagar, *Ecklon* s.n.

Dicranum leucobasis C. Müll. in Hedwigia 38: 78 (1899). *Campylopus leucobasis* (C. Müll.) Par., Ind. Bryol. Suppl. 93 (1900); Dix. in Trans. R. Soc. S. Afr. 8: 184 (1920). Type: Cape, Montagu Pass, *Rehmann* 71 (NH!; PRE!).

Dicranum weisiopsis C. Müll. in Hedwigia 38: 79 (1899). *Campylopus weisiopsis* (C. Müll.) Par., Ind. Bryol. Suppl. 99 (1900); Broth. in Natürl. PflFam. 10: 184 (1924). Type: Cape, Table Mountain, *Rehmann* 61 PC!).

Campylopus echinatus Sim, Bryo. S. Afr. 175 (1926), nom. illeg. Syntypes: Cape, *Rehmann* 67, 68, 69, 70, 71, 72; *Sim* 8581b, 8604; Natal, *Sim* 9837 (PRE!).

Plants medium to large, in cushions, yellow-green to green above, frequently with reddish tomentum below; terricolous. *Stems* (5–)10–20 mm tall, rarely branched; in section round, central strand large, inner cortical cells in 3–5 rows, large, thin-walled, outer cortical cells in 1–3 rows, smaller, substereids, red-brown. *Leaves* frequently comose at stem apex and occasionally at intervals along older stems, appressed dry, erect-spreading wet, oblong to elliptical, acuminate, 3–7 mm long; base scarcely differentiated; margins incurved above, entire. *Costa* $\frac{1}{3}$–$\frac{3}{5}$ of width of leaf base, long excurrent up to 2 mm as a hyaline, dentate awn, frequently reflexed, or infrequently percurrent, apex with short hyaline tip; in proximal section guide cells 27–30, ventral cells in single layer, large, weakly thickened, dorsal stereid cells in small groups of 2–4 cells, occasionally substereids, stereid groups separated by large, incrassate cells, dorsal surface with single large, incrassate cells below stereid groups; in distal section ventral cells similar, dorsal cells generally substereids

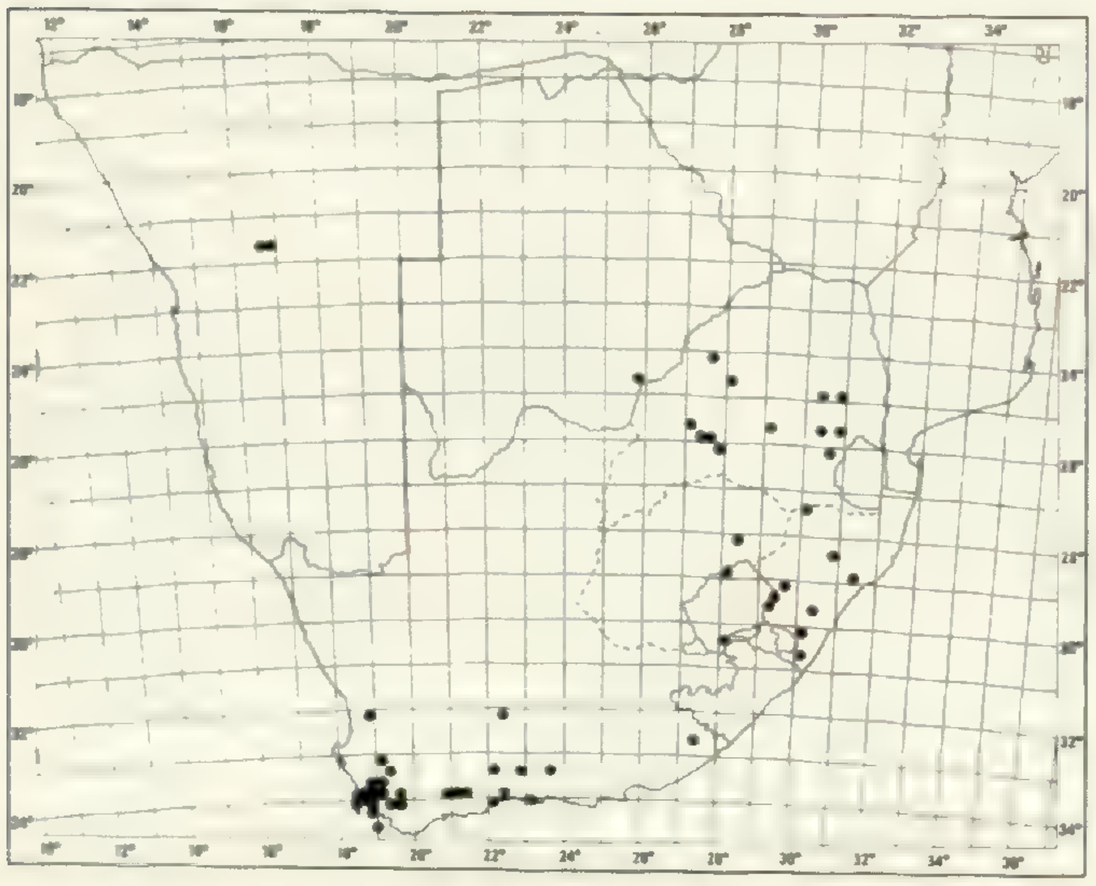
throughout, dorsal surface with lamellae, 1–2 cells long. *Upper laminal cells* short-rectangular to rhomboidal or quadrate; basal cells moderately differentiated, reaching higher along margin than costa, rectangular to elongate, thin-walled, hyaline; alar cells variably differentiated, short-rectangular, thin-walled, reddish.

Sporophyte not known from Southern Africa (Gradstein & Sipman, 1978). Fig. 41: 1–11.

Campylopus introflexus is presently recognized from southern South America, Southern Africa, Australia and New Zealand, and has been introduced into England and Europe. In Southern Africa the species is known from fynbos, grasslands and woodlands of the Cape, Natal, Zululand, Lesotho, Orange

FIG. 41.—**Campylopus introflexus** (1–11): **1.** habit, ×1; **2.** habit, ×1; **3.** habit, ×3; **4.** leaf, ×20; **5.** leaf in proximal cross section (left half), ×170; **6.** leaf in distal cross section (left half), ×170; **7.** cells at leaf base (right side), ×170; **8.** junction of basal and laminal cells, ×170; **9.** tip of awn, ×170; **10.** basal leaf cells, ×170; **11.** upper laminal cells, ×640. **C. pilifer** (12–20): **12.** habit, ×1; **13.** habit, ×1; **14.** habit, ×3; **15.** leaf, ×20; **16.** leaf in proximal cross section (left half), ×170; **17.** leaf in distal cross section (right half), ×170; **18.** cells at leaf base (right side), ×170; **19.** upper laminal cells, ×640; **20.** tip of awn, ×170. (1–11, *Magill* 6060; 12–20, *Cholnoky* 962).

Free State, Transvaal and from a few collections from southeastern Botswana and central South West Africa/Namibia. Although uncommon throughout its range in Southern Africa, the species is more frequently collected in the southern and southwestern Cape. Map 56.



MAP 56.— ● **Campylopus introflexus**

Vouchers: *Cholnoky* 419, 727; *Jacot Guillarmod* 8104; *Hardy* 4264; *Lavranos* 15207c; *Magill* 4415, 6060; *Schelpe* 7916; *Van Rooy* 71.

The extreme variability of *C. introflexus* in most of its distinguishing characters makes identification of some specimens very difficult. In its typical form, with comose tufts of leaves at the stem apex and long, hyaline, reflexed awns, the species is easily recognized, but only about 40% of the Southern African specimens have this combination of characters. Over 50% of the specimens examined did not have reflexed awns or in some cases lacked awns altogether.

A considerable degree of variation in the development of stereids in the costa was observed throughout the range of the species. The smaller plants frequently show weak development of stereid groups. Many of the forms of *C. introflexus* in Southern Africa approach the habit of *C. pilifer*. Several recent publications (vide Frahm, 1974; Gradstein & Sipman, 1978) have discussed the differences between the two species. Southern Africa is one of the few areas where the species are sympatric. In addition to the characters used in the key, *C. pilifer* is more common in the northern parts of the Flora area, while *C. introflexus* is more common in the south. See also notes under *C. pilifer*.

11. **Campylopus pilifer** *Brid.*, Mant. Musc. 72 (1819); Frahm in Rev. bryol. lich. 40: 33–44 (1974); Gradstein & Sipman in Bryologist 81: 114–121 (1978). Type: Italy, 'In Insula Ischia ad rupes, Auguste 1806' (B, lecto.).

Campylopus polytrichoides De Not., Syll. Musc. 222 (1838); Broth. in Natürl. PflFam. 10: 187 (1924). Type: Europe.

Campylopus purpurascens Lor., Moosstud. 158 (1864); Broth. in Natürl. PflFam. 10: 187 (1924); Sim, Bryo. S. Afr. 176 (1926). Type: Cape, Table Mountain, *Ecklon* s.n. (NY, holo.!).

Campylopus trichodes Lor., Moosstud. 159 (1864); Broth, in Natürl. PflFam. 10: 187 (1924); Sim, Bryo. S. Afr. 168 (1926). Type: Cape, Table Mountain, *Ecklon* s.n. (NY!).

Dicranum griseolus C. Müll. in Hedwigia 38: 80 (1899). *Campylopus griseolus* (C. Müll.) Par., Ind. Bryol. Suppl. 92 (1900); Broth. in Natürl. PflFam. 10: 187 (1924); Sim, Bryo. S. Afr. 167 (1926). Type: Transvaal, Lydenburg, *Wilms* s.n., 1887 (G, holo.!).

Dicranum purpureoaureus C. Müll. in Hedwigia 38: 82 (1899). *Campylopus purpureoaureus* (C. Müll.) Par., Ind. Bryol. Suppl. 96 (1900); Broth. in Natürl. PflFam. 10: 187 (1924). Syntypes: Transvaal, Duivels Krackler, near Lydenburg, *Wilms* s.n., 1887 (G); Liebenbergsvley, *Rehmann* 59 (PRE!).

Campylopus trichodes var. *perlamellosus* Dix. in S. Afr. J. Sci. 18: 304 (1922); Sim, Bryo. S. Afr. 168 (1926). Syntypes: Zimbabwe, Rhodes's Grave, Matopos, *Sim* 8858 (BM!; PRE!); Natal, Tugela River, *Bews* sub *Sim* 8374; (BM!; PRE!).

Campylopus bewsii Sim, Bryo. S. Afr. 176 (1926). Syntypes: Natal, Zwartkop, *Sim* 9838 (PRE!); Mont-Aux-Sources, *Bews* sub *Sim* 9891 (PRE!); Giant's Castle, *Symons* s.n. (PRE!).

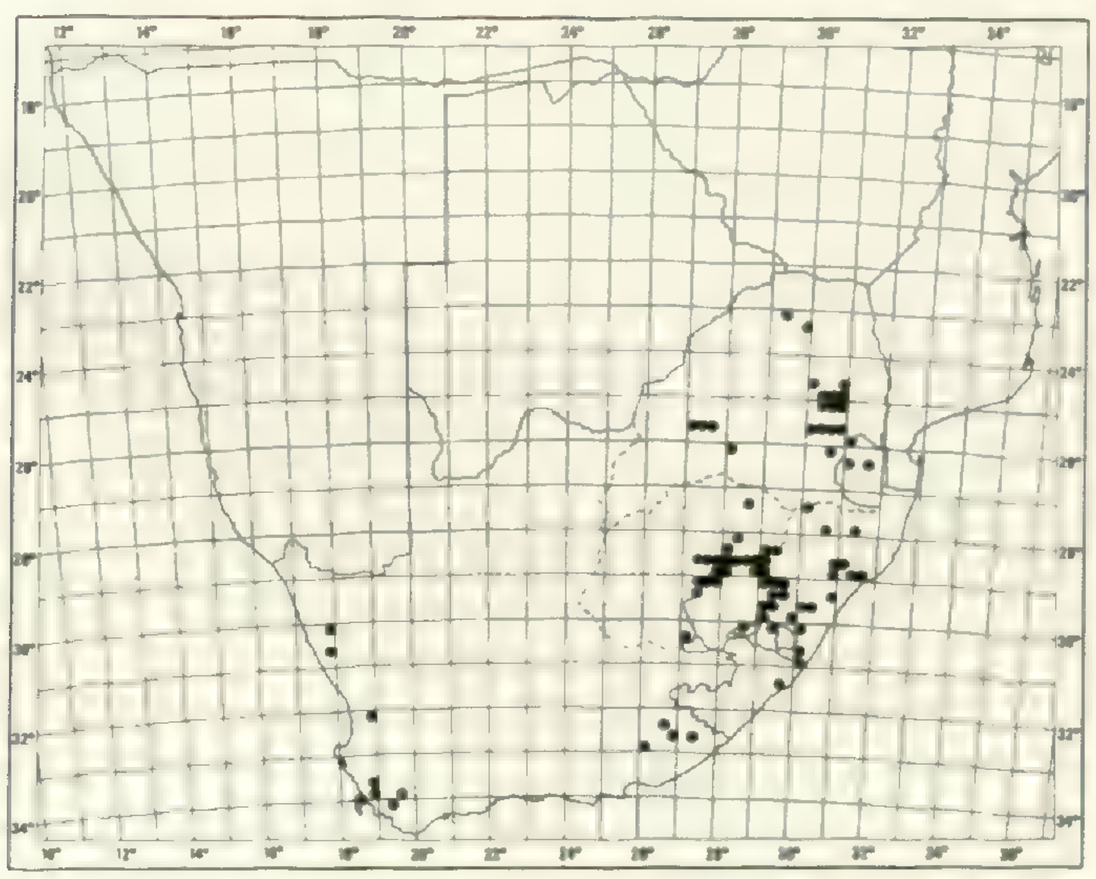
?*Campylopus symonsii* Sim, Bryo. S. Afr. 167 (1926). Syntypes: Natal, Giant's Castle, *Symons* sub *Sim* 9843, 9835 (PRE!).

Plants large to robust, forming large turfs or cushions, green to yellow-green above, black-green below; terricolous or saxicolous. *Stems* (5–)10–40 mm tall, infrequently branched; in section round, central strand small, inner cortical cells in 6 rows, of medium size, weakly thickened, outer cortical cells in 2–4 rows, stereids, reddish. *Leaves* crowded, rarely comose at stem apex, elliptical to ovate-oblong, acuminate to subulate, (3–)4–7 mm long; base auriculate to scarcely differentiated; margins entire, erect to incurved above. *Costa* $\frac{1}{2}$–$\frac{3}{4}$ of width of leaf base, short-excurrent as denticulate, hyaline awn 0,2–2,0 mm long; in proximal section guide cells c. 30, ventral cells in single layer, large, thin-walled, rarely thickened, centred, exposing 2–4 guide cells on either side, dorsal stereids in small groups, 3–4 cells each, stereid groups separated by larger incrassate cells, occasionally all dorsal

cells similar, strongly incrassate, dorsal surface with lamellae under stereid groups, 2–4 cells long; in distal section costa narrower, ventral cells somewhat smaller, occasionally strongly incrassate, dorsal anatomy similar, dorsal lamellae 4–6 cells long. *Upper laminal cells* quadrate to angular, incrassate, median laminal cells rectangular, rhomboidal or elongate, shapes generally mixed, incrassate; basal cells moderately differentiated, reaching higher along margin than costa, rectangular, thin-walled, hyaline; alar cells quadrate, thin-walled, reddish or hyaline.

Sporophytes not known in Southern Africa (Gradstein & Sipman, 1978). Fig. 41: 12–20.

Widespread in Europe, Asia, the Americas and Africa, *C. pilifer* is most common in grasslands and woodlands of the Transvaal, Swaziland, Zululand, Natal, Lesotho and Orange Free State. Specimens have also been occasionally collected in the eastern and western Cape. Map 57.



MAP 57.— ● **Campylopus pilifer**

Vouchers: *Cholnoky* 285, 501; *Esterhuysen* 20224; *Hilliard & Burtt* 10408; *Jacobsz* 5010; *Magill* 3364, 5593; *Pienaar* 20; *Smook* 1425.

Although similar to *C. introflexus*, the present species is generally separated by the longer dorsal costal lamellae. In addition *C. pilifer* only rarely has comose tufts (heads) of leaves at the stem apex and never has reflexed awns.

Specimens of *C. symonsii* are here considered only a facies of *C. pilifer*. The specimens, which are fairly widespread in upper elevations of the Drakensberg, could, however be separated by their very long, somewhat recurved, serrate hair-points, and spurred costa with an undivided dorsal stereid or substereid band.

12. **Campylopus procerus** (*C. Müll.*) *Par.*, Ind. Bryol. 258 (1894); Broth, in Natürl. PflFam. 10: 186 (1924). Type: Tanzania, Mt Kilimandjaro, *Meyer* s.n., 1889 (BM!; PC!).

Dicranum procerus C. Müll. in Flora, Jena 73: 472 (1890).

Plants large to robust, loosely caespitose, yellow-green above, blackish below; saxicolous. *Stems* 30–90 mm tall, branching below, frequently with reddish tomentum below; in section round, central strand very small, inner cortical cells in 5–6 rows, medium-sized, yellowish, outer cortical cells in 2–3 rows, smaller, stereids, dark red. *Leaves* twisted, curved dry, widely spreading to recurved wet, oblong to elliptical, setaceous, 7–12 mm long; base scarcely differentiated, rounded; margins inrolled to erect above, denticulate to dentate above. *Costa* ⅘ of width of leaf base, percurrent; in proximal section guide cells 46–60, small, ventral cells large, lax, completely covering guide cells, dorsal stereid groups small, of 2–3 cells, stereid groups separated by larger incrassate cells, dorsal surface flat; in distal section ventral cells smaller, dorsal stereid groups distinct, dorsal surface flat. *Upper laminal cells* small, quadrate, rectangular or rhomboidal, incrassate; basal cells weakly differentiated, large, rectangular to rhomboidal, incrassate, pitted; alar cells differentiated, thin-walled, reddish.

Perichaetia terminal, polysetaceous, leaves convolute, oblong-setaceous, 8–12 mm long. *Seta* flexuose to cygneous, to 10 mm long, yellowish to red-brown; capsule arcuate, plicate dry; urn elliptical, to 2 mm long, strumose; exothecial cells rectangular, incrassate; peristome teeth 16, triangular, 0,4 mm long, cleft above, striate below, papillose, hyaline above; operculum rostrate, 1,3 mm long; calyptra cucullate, 2,5 mm long, fringed; spores round, 12–17 μm, weakly papillose. Fig. 40: 22–33.

Known from central, western and Southern Africa, *C. procerus* is infrequent throughout its range. In Southern Africa the species is rarely collected on rock in forests of the eastern Transvaal. Map 52.

Vouchers: *Crosby & Crosby* 13401; *Smook & Phelan* 845; *Vorster* 486a.

Stems and leaves of *C. procerus* are considerably longer than those of any of the other Southern African species. In addition the very prominent ventral cells of the costa give the leaf sections a distinctive appearance.

Insufficiently Known Species

Campylopus aureoviridis (C. Müll.) Schimp. ex Par., Ind. Bryol. Suppl. 89 (1900). Basionym: *Dicranum aureoviridis* C. Müll. in Hedwigia 38: 88 (1899). Type: Cape, Houteniqua, *Breutel* s.n., 1862. The type has not been seen; however Sim (1926) refers the species to *C. atroluteus* (C. Müll.) Par.

7. CHORISODONTIUM

Chorisodontium (*Mitt.*) *Broth.* in Natürl. PflFam. 10: 204 (1924); Bell in Br. Antarct. Surv. Bull. 37: 33 (1973); Robinson in Smiths. Cont. Bot. 27: 24 (1975). Type species: not designated.

Dicranum sect. *Chorisodontium* Mitt. in J. Linn. Soc., Bot. 12: 62 (1869).

Plants large, caespitose; saxicolous. *Stems* erect; central strand present. *Leaves* erect to falcate-secund, lanceolate-subulate, frequently subconvolute; margins serrate to entire, without borders. *Costa* broad, occupying ⅓ width of leaf base, filling subula; in section guide cells numerous, dorsal and ventral stereid bands strong, dorsal surface cells vertically elongate, occasionally projecting dorsally as large sharp mammillae. *Laminal cells* rectangular to linear, incrassate, occasionally pitted; basal cells rectangular, thin-walled; alar cells greatly enlarged, reddish.

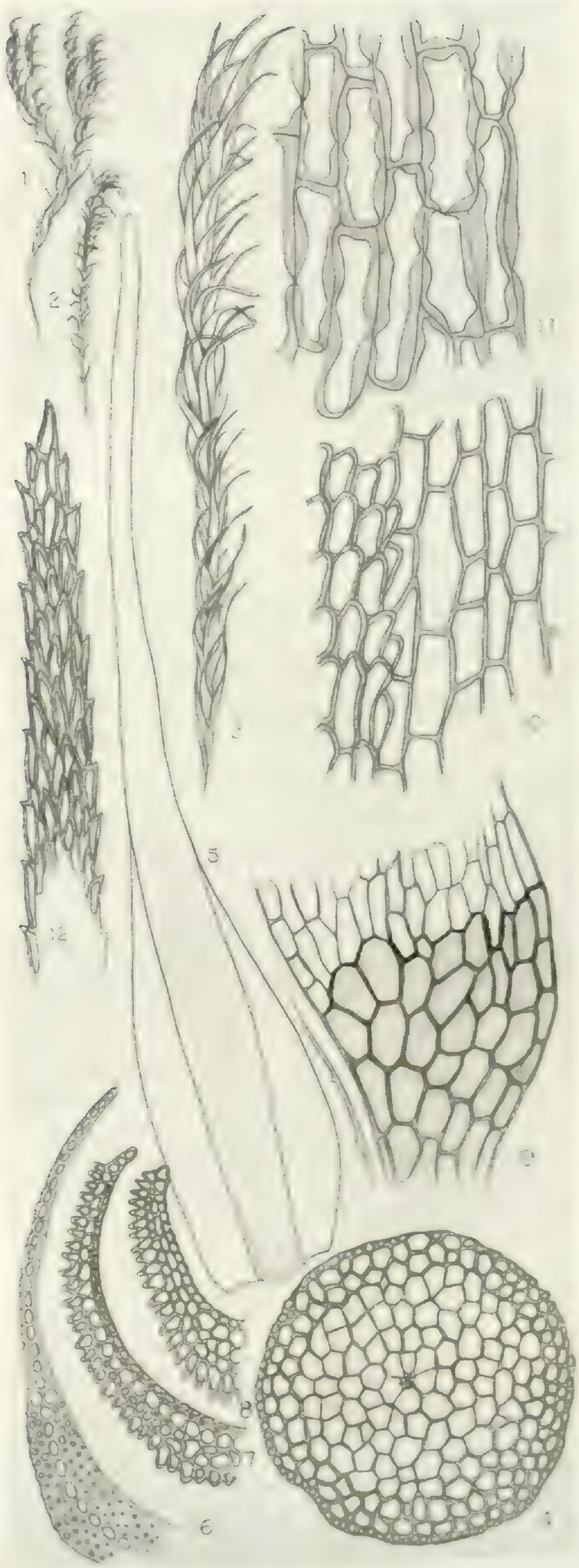
Dioicous. Perichaetia terminal, leaves little differentiated. *Seta* long, straight; capsules erect, cylindrical, slightly asymmetrical; peristome teeth cleft to middle, striolate below; operculum long-rostrate; calyptra cucullate, base entire; spores often large.

The 14 species of *Chorisodontium* are found in the Subantarctic Islands, Africa and South America northward along the Andes to Central America. The following new species is the first report of the genus for the African continent. The genus is similar to *Campylopus*; the two genera are most easily separated on costal anatomy, leaf cell shape and ornamentation as well as several sporophyte characters.

Chorisodontium falcatum *Magill*, sp. nov., *habitu* C. aciphyllo (*Hook. f. & Wils.*) *Broth. et* C. dicranellato (*Dus.*) *Roiv. simile, sed foliis falcato-secundis, subula valde serrata, pagina dorsale costae mammillosissima et anatomia costae differt.*

Type: Cape, Hex River Mountains, Roodeberg, on rock, *Esterhuysen* 20972 (BOL, holo.; H; L; MO; NY; PRE).

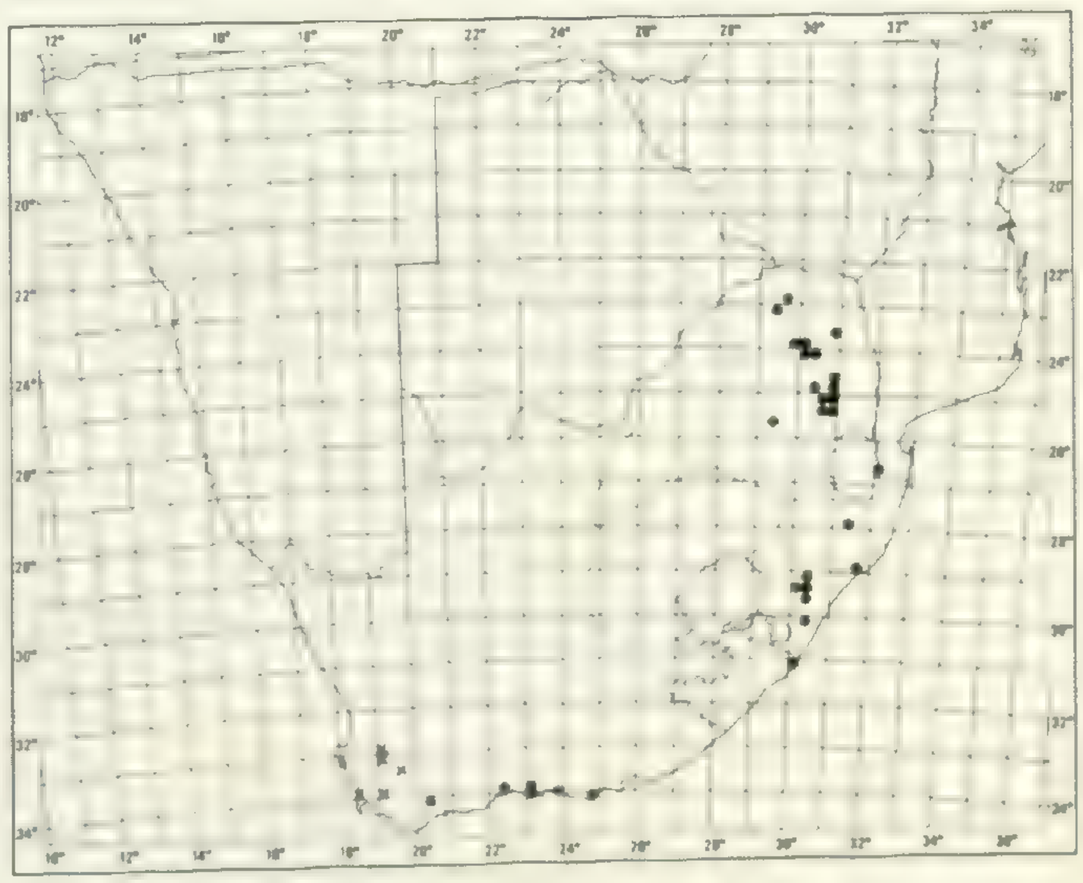
Plants large, caespitose, green to yellow-green above, brownish below; saxicolous. *Stems* 30–70 mm tall, occasionally branching, with sparse, reddish or whitish tomentum below; in section round, central strand small, inner cortical cells large, in 4–6 rows, outer cortical cells small, weakly thickened, in 2–3 rows. *Leaves* somewhat crowded, falcate-secund with flexuose subulae dry, falcate-secund but less flexuose wet, subulate to setaceous above oblong to oval base, 6–9 mm long; ventral surface broadly channelled above; margin erect, strongly serrate or occasionally almost entire. *Costa* broad, ⅓ of width of leaf base, filling subula, ventral superficial cells linear, smooth, dorsal superficial cells rectangular, becoming shorter above base, sharply mammillose; in section ventrally concave, guide cells (20–) 30–34(–50) above base, medium-sized, strongly thickened; in proximal section ventral stereid band strong, 2–4 cells thick, ventral surface cells not differentiated, dorsal stereid band strong, 3–4 cells thick, dorsal surface cells not differentiated; in distal section ventral substereid band 2 cells thick centrally, quadrate, laterally cells in single layer, quadrate, incrassate, ventral surface cells not differentiated, dorsal internal cells in 2 layers, slightly smaller than guide cells,



absent laterally, dorsal surface cells vertically elongate, incrassate, projecting dorsally as large, sharp mammillae, tip of mammillae strongly thickened. *Laminal cells* rectangular, incrassate, frequently irregularly thickened, pitted, smooth; in section strongly thickened, lumens horizontally compressed; basal cells becoming long-rectangular, thin-walled, linear at basal margin; alar cells large, broadly rectangular, thin-walled, reddish.

Sporophyte not known. Fig. 42: 1–12.

The species is presently known from rock recesses and shaded ledges at the base of cliffs at upper elevations in the mountains of the southwestern Cape. The species has also been collected on Kerguelen Island (*Engel* 7334, 7345, 7355 (ALTA), comm. D. H. Vitt). Map 58.



MAP 58.— ● **Leucobryum acutifolium**
× **Chorisodontium falcatum**

Vouchers: *Esterhuysen* 16827, 21334, 27048, 27864; *Wilms* 2567 (G!).

This species is similar to *C. aciphyllum* (Hook. f. & Wils.) Broth. and *C. dicranellatum* (Dus.) Roiv. but differs in the falcate, secund leaves, strongly serrate subulae, coarsely mammillose dorsal costa and costal anatomy.

FIG. 42.—**Chorisodontium falcatum: 1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, ×3; **4.** stem in cross section, ×100; **5.** leaf, ×20; **6.** leaf in proximal cross section (left half), ×170; **7.** leaf in median cross section (left half), ×170; **8.** leaf in distal cross section (left half), ×170; **9.** cells at leaf base (right margin), ×170; **10.** juxtacostal cells (dorsal surface), ×640; **11.** upper laminal cells, ×640; **12.** tip of subula, ×170. (1–12, *Esterhuysen* 20972).

Subfamily LEUCOBRYOIDEAE

Plants small to large, in dense cushions, glaucous-green; terricolous or saxicolous. *Stesm* erect, with or without central strand. *Leaves* thickened, consisting mostly of broad, multilayered costa; in section with single row of small, rhombic chlorocysts surrounded by 2–8 layers of large, hyaline leucocysts. *Laminal cells* large, hyaline, confined mostly to leaf base.

Perichaetia terminal. *Seta* erect; capsule erect, frequently cylindrical, strumose; peristome teeth cleft to middle, vertically striate below, papillose above; operculum rostrate; calyptra cucullate.

Only a single genus of this subfamily, *Leucobryum*, is represented in Southern Africa.

The family Leucobryaceae is not recognized here. The genera frequently treated in Leucobryaceae are gametophytically similar; however, sporophyte characters, especially peristome architecture, clearly illustrate the heterogeneity of the family. The genera of Leucobryaceae have therefore been divided between the families Dicranaceae and Calymperaceae (fide Crosby & Magill, 1977). Only two Southern African genera are involved: *Leucobryum* with a dicranaceous peristo ne is placed in Dicranaceae and *Octoblepharum* is moved to Calymperaceae.

LEUCOBRYUM

Leucobryum *Hampe* in Linnaea 13: 42 (1839); Broth. in Natürl. PflFam. 10: 223 (1924); Sim, Bryo. S. Afr. 181 (1926). Type species: *L. glaucum* (Hedw.) Schimp.

Plants medium to large, forming large cushions, whitish to glaucous-green; terricolous or saxicolous. *Stems* branching below, central strand present or absent. *Leaves* crowded, thickened, fleshy, lanceolate to oval-ligulate; apex acute to obtuse; lamina narrow, restricted to base, hyaline. *Costa* filling upper leaf; in section leucocysts in 2–8 layers, enclosing ± median chlorocysts. *Laminal cells* quadrate, rectangular or fusiform, thin-walled, hyaline.

Dioicous. Dwarf male plants growing on or among leaves of female plants. Perichaetia terminal. *Seta* erect, elongate; capsule inclined, asymmetric, 8-ribbed dry, strumose; peristome teeth 16, triangular, deeply cleft, vertically striate below; operculum long-rostrate; calyptra cucullate.

Leucobryum contains 124 species and is found in tropical and temperate regions throughout the world. In Southern Africa the genus is infrequently collected in forests or dense woodlands.

1 Plants large; leaves in distal section with leucocysts in 5–8 rows ..... 3. *L. madagassum*
1 Plants medium; leaves in distal section with leucocysts in 2 rows:
2 Leaves 3–6 mm long, spreading wet ..... 1. *L. acutifolium*
2 Leaves 7–10 mm long, generally falcate wet ..... 2. *L. rehmannii*

1. **Leucobryum acutifolium** (*Mitt.*) *Card.* in Bull. Herb. Boissier, sér. 2, 4: 105 (1904); Broth. in Natürl. PflFam. 10: 224 (1924). Syntypes: Tanzania, Usagara Mountains, *Hannington* s.n.; *Last* s.n.; Natal, *Saunders* s.n.; Madagascar, *Meller* s.n. (all NY!).

Schistomitrium acutifolium Mitt. in J. Linn. Soc., Bot. 22: 302 (1886); Sim, Bryo. S. Afr. 183 (1926).

Leucobryum gueinzii C. Müll. in Hedwigia 38: 58 (1899); Broth. in Natürl. PflFam. 10: 224 (1924); Sim, Bryo. S. Afr. 183 (1926). Syntypes: Cape, Montagu Pass, *Rehmann* 74 (PRE!); Natal, *Gueinzius* s.n.

FIG. 43.—**Leucobryum madagassum** (1–8): **1.** habit, ×1; **2.** habit, ×5; **3.** leaf, ×20; **4.** leaf in proximal cross section, ×70; **5.** leaf in distal cross section, ×70; **6.** cells at leaf base (left side), ×170; **7.** cells at leaf margin, ×640; **8.** leaf apex, ×170. **L. acutifolium** (9–16): **9.** habit, ×1; **10.** habit, ×5; **11.** stem in cross section, ×170; **12.** leaf, ×20; **13.** leaf in proximal cross section, ×70; **14.** leaf in distal cross section, ×70; **15.** cells at leaf margin, ×640; **16.** leaf apex, ×170. **L. rehmannii** (17–24): **17.** habit, ×1; **18.** habit, ×5; **19.** leaf, ×20; **20.** leaf in proximal cross section, ×70; **21.** leaf in distal cross section, ×70; **22.** cells at leaf margin, ×170; **23.** upper leaf cells, ×640; **24.** leaf apex, ×170. (1–8, *Wager* PRE-CH12038; 9–16, *Rehmann* 74; 17–24, *Rehmann* 75).

Plants small, loosely caespitose, glaucous-green; corticolous or saxicolous. *Stems* 5–10 mm tall, unbranched; in section round, central strand very small, weak, inner cortical cells in 4–5 rows, thickened, outer cortical cells in 1–2 rows, smaller, reddish. *Leaves* contorted dry, spreading wet, elliptical to oblong, 3–6 mm long; lamina narrow, unistratose; apex acuminate, apiculate; margins entire, broadly incurved above. *Costa* broad; in proximal section chlorocysts small, rhomboidal, ventral leucocysts in 1(–2) layer(s), dorsal leucocysts in 1 layer medianly, 2–3 layers laterally; in median and distal sections ventral and dorsal leucocysts in single layers. *Upper laminal cells* in 9–12 rows on either side of costa, rectangular to quadrate, infrequently some cells triangular, thin-walled, pitted; marginal cells rectangular to linear, narrower above, extending to apex, hyaline.

Perichaetia terminal, leaves convolute, acuminate, 4 mm long. *Seta* 10–15 mm long, reddish; capsule curved, striated dry, strumose, urn 1,0–1,5 mm long; peristome red-yellow, teeth 16, triangular, cleft to below middle, 0,5 mm long; vertically striate below, papillose above; operculum long-rostrate, 1,0–1,5 mm long; calyptra cucullate, 2,5 mm long, smooth; spores round, 15–17 μm, papillose, green. Fig. 43: 9–16.

This species is known from east Africa, the East African Islands and Southern Africa. In the Flora area, *L. acutifolium* is infrequently collected in mountain or escarpment forests of the northern and eastern Transvaal, Swaziland, and lowland forests of Zululand, Natal, and the southern and southwestern Cape. Map 58.

Vouchers: *Cholnoky* 663; *Crosby & Crosby* 9206; *Kemp* 807; *Kluge* 1054; *Magill* 3815; *Oliver* 7061; *Rankin* 144; *Schelpe* 7861.

Leucobryum acutifolium is separated from the other Southern African species by its smaller size, shorter leaves and leucocysts in distal leaf section in two rows.

Thériot (1929) reported *L. isleanum* Besch. for Southern Africa, from a Junod specimen, collected in the northern Transvaal. A duplicate of the specimen (G!) was examined and appears to be *L. acutifolium*. The author could not locate the type of *L. isleanum* among the specimens from the Bescherelle collection (BM), so its relationship to *L. acutifolium* could not be assessed. *Leucobryum isleanum* is provisionally excluded from the Flora.

Leucobryum parvulum Card. was reported (Bizot, 1967) from Mt Anderson near Sabie in the eastern Transvaal. One of the syntypes (*Perrot* 86, PC!) was examined; it is very similar to *L. acutifolium*. A more comprehensive study must be undertaken to confirm the relationship between these two species. The species is provisionally excluded from the Flora.

2. **Leucobryum rehmannii** *C. Müll.* in Hedwigia 38: 58 (1899). Type: Cape, Knysna, Esternek, *Rehmann* 75 (BOL!; NH!; PRE!).

Leucobryum perfalcatum Sim, Bryo. S. Afr. 182 (1936), hom. illeg. Type: Knysna, Esternek, *Rehmann* 75 (PRE!; BOL!; NH!).

Leucobryum gracilifolium Dix. in K. norske Vidensk. Selsk. Skr. 1932(4): 4 (1932). Syntypes: Cape, Knysna, Deep Walls Forest Station, *Hφeg* 95, 102 (BM!).

Plants small to medium, in cushions, glaucous-green, tan below; terricolous or corticolous. *Stems* 10–20 mm tall, irregularly branched below; in section round, central strand present, inner cortical cells in 4–5 rows, incrassate, outer cortical cells in 2 rows, smaller, red-brown. *Leaves* crowded, ± contorted dry, spreading to frequently falcate wet; elliptical, abruptly acuminate, 7–10 mm long; lamina narrow, unistratose; base scarcely differentiated; margins entire, plane below, inrolled above. *Costa* broad; in section chlorocysts small, rhomboidal, at base ventral leucocysts in 1 row medianly, 1(–2) row(s) laterally, dorsal leucocysts in 1 row medianly, 2–3 rows laterally, in upper proximal and distal sections ventral and dorsal leucocysts in single layers. *Upper laminal cells* in 6–7 rows on either side of costa, irregularly rectangular to fusiform, very thin-walled, pitted, hyaline.

Sporophyte not known. Fig. 43: 17–24.

Endemic to Southern Africa, *L. rehmannii* has been collected rarely in the evergreen forests of the southern Cape Province. Map 59.

Vouchers: *Crosby & Crosby* 7986, 9245; *Russell* 2522.

This species is very closely related to *L. acutifolium* and may represent only a robust form of that species. *Leucobryum rehmannii* is provisionally maintained here because of the consistently larger plants, longer, generally falcate leaves, and longer laminal cells.

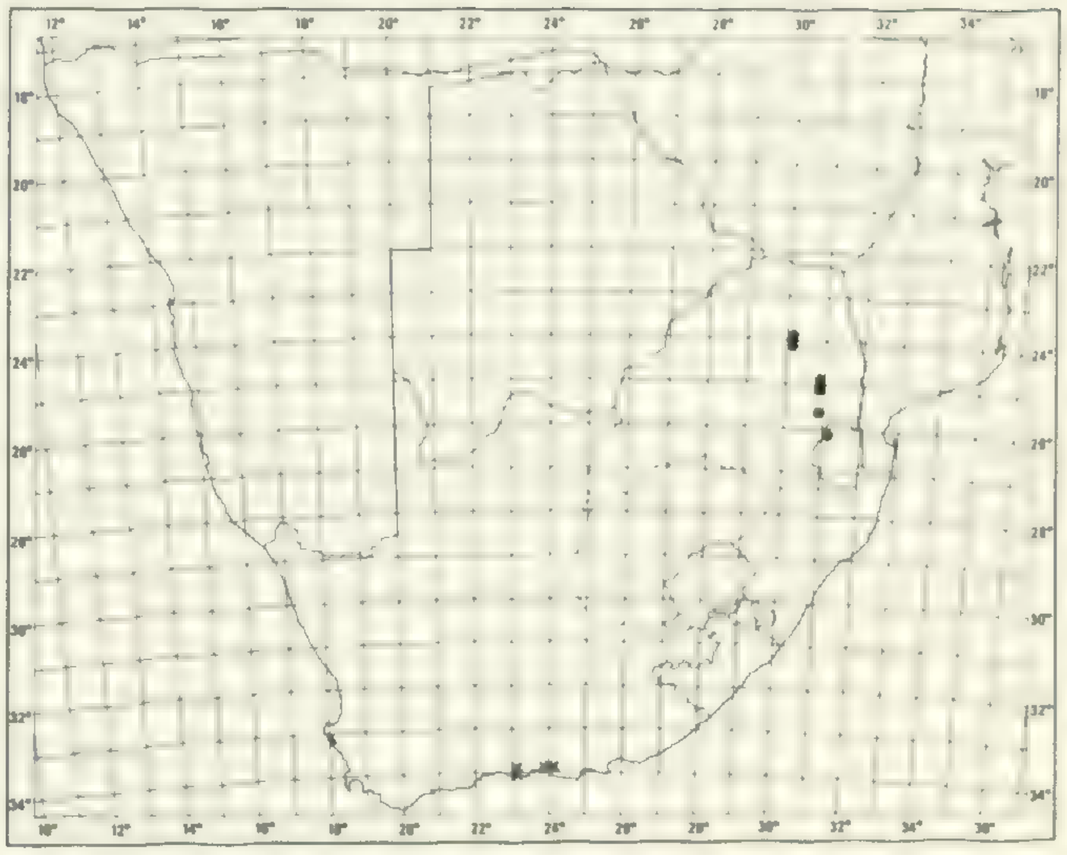
The distribution area of *L. rehmannii* is very small when compared with the African distribution area of *L. acutifolium*. Both species occur in the southern Cape, but as yet are not known from the same forests.

3. **Leucobryum madagassum** *Besch.* in Annls Sci. nat. Bot., sér. 6, 9: 337 (1880); Broth. in Natürl. PflFam. 10: 224 (1924); Sim, Bryo. S. Afr. 182 (1926). Type: Madagascar, *Rosas* s.n., 1876 (BM!; PC!).

Plants large to robust, in cushions, glaucous-green; saxicolous. *Stems* 10–40 mm tall, irregularly branched below; in section round, central strand absent, inner cortical cells medium-sized, yellowish, outer cortical cells in 1–2 rows, slightly smaller, red-brown. *Leaves* appressed dry, erect-spreading wet, broadly lanceolate to oblong, 5,0–7,5 mm long, concave; lamina narrow, unistratose; apex acuminate; base scarcely differentiated, rounded; margins entire, broadly incurved above. *Costa* broad; in proximal section chlorocysts small, rhomboidal, ventral leucocysts in 2 layers, infrequently small areas with 3 layers, dorsal leucocysts in 2(–3) layers; in distal section chlorocysts rhomboidal, ventral leucocysts in 2(–3) layers, narrowing to 1 layer marginally, dorsal leucocysts in 3(–4) layers, abruptly narrowing at margin. *Upper laminal cells* in 6–9 rows on either side of costa, rectangular, thin-walled, pitted; marginal cells in 2–3 rows, linear, hyaline, extending to apex.

Sporophyte not known in Southern Africa. Fig. 43: 1–8.

Leucobryum madagassum is known from east Africa, the East African Islands and Southern Africa.



MAP 59.— ● **Leucobryum madagassum**
× **Leucobryum rehmannii**

In Southern Africa the species has been collected in forests of the northern and eastern Transvaal and Swaziland. Map 59.

Vouchers: *Cholnoky* 586; *Magill* 3505; *Stirton* 6980; *Vorster* 2144.

Leucobryum madagassum is considerably larger than the other two Southern African species. In addition, the leaf in distal section has leucocysts in 5–8 layers; in both of the other species the leucocysts are in 2 rows.

CALYMPERACEAE

Plants small to medium, in loose tufts or cushions; terricolous, saxicolous or corticolous. *Stems* erect; central strand present or absent. *Leaves* elongate above broad, sheathing, ± hyaline base; margins frequently thickened, toothed, or with hyaline border of elongated cells, occasionally with intermarginal bands (teniolae) of elongated cells. *Costa* strong, percurrent or excurrent, occasionally gemmiferous apically. *Upper laminal cells* small, papillose; frequently inner basal cells (cancellinae) enlarged, hyaline; sometimes leaves modified, having chlorocysts surrounded by several layers of leucocysts. *Gemmae* multicellular, cylindrical, frequently produced at leaf apices.

Seta erect, elongate; capsules, erect, urn ± cylindrical; peristome teeth 8, 16 or absent; calyptra large, cucullate or campanulate, sometimes persistent.

A small family of 14 genera with tropical to temperate distributions.

1 Leaves several cells thick above; chlorocysts small, triangular, surrounded by large leucocysts.....1. **Octoblepharum**

1 Leaf lamina unistratose above, margins frequently thickened:

2 Stem with small central strand; laminal cells not extending down margin..... ..... 4. **Hypodontium**

2 Stem without central strand; laminal cells extending down margin or between margin and cancellinae:

3 Leaves with cartilaginous border of narrow, elongated, hyaline cells....3. **Syrrhopodon**

3 Leaves without border of elongated cells, teniolae occasionally present:

4 Leaf margins serrate, denticulate or smooth.....2. **Calymperes**

4 Leaf margins strongly and irregularly dentate, spinose at shoulders...3. **Syrrhopodon**

1. OCTOBLEPHARUM

Octoblepharum *Hedw.*, Spec. Musc. 50 (1801); Broth. in Natürl. PflFam. 10: 225 (1924); Sim, Bryo. S. Afr. 183 (1926). Type species: *O. albidum* Hedw.

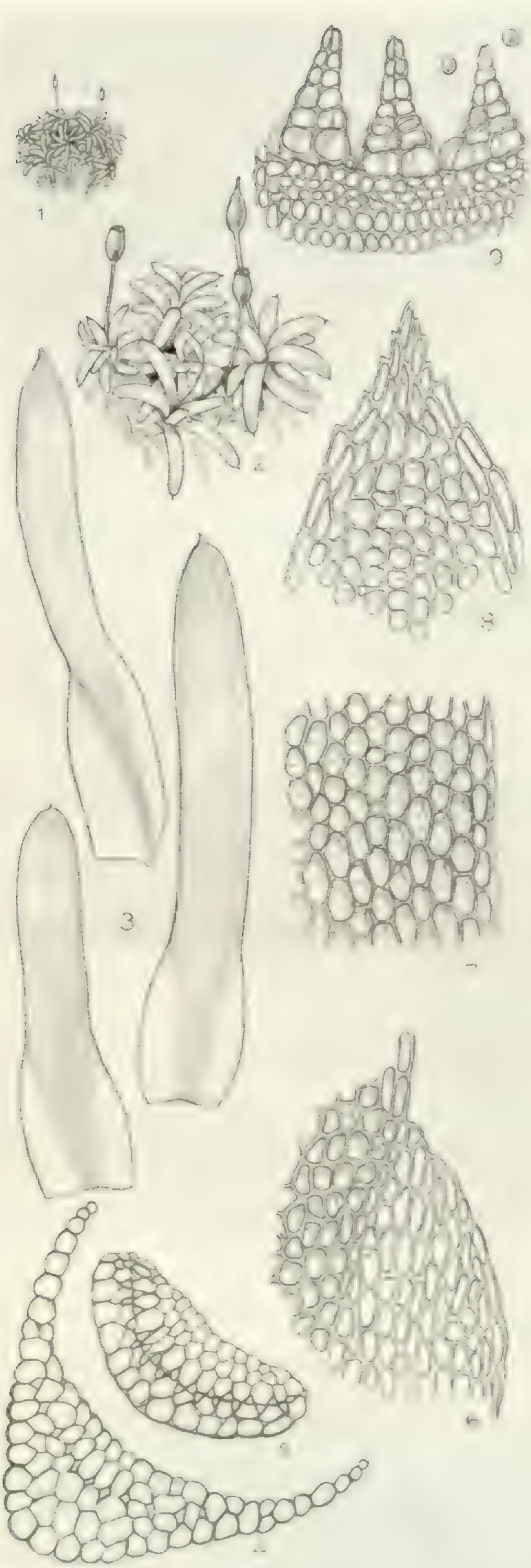
Plants glaucous, loosely caespitose. *Stems* short, erect. *Leaves* strap-shaped above oval base; multistratose above, small triangular chlorocysts surrounded by large leucocysts.

Perichaetial leaves undifferentiated. *Seta* short, erect; capsule exserted, short; peristome short, teeth 8; calyptra cucullate.

A genus of 16 species of tropical and subtropical distribution, *Octoblepharum* is rare in the northern and eastern parts of the Flora area.

The leaf anatomy indicates that the upper, multistratose part of the leaf is a modified costa and the oval, basal region is the lamina.

The family Leucobryaceae (see note under Dicranaceae subfamily Leucobryoideae) is not recognized in the Flora. The genus *Octoblepharum* should, however, be segregated at the subfamily level (Octoblepharoideae) from the rest of Calymperaceae in the Flora area. The family Leucophanaceae, recognized 'primarily by possessing the leucobryoid leaf' (vide Edwards, 1980) is also not taken up here, because of the rather heterogeneous leaf morphology exhibited by the group. A great deal of research is needed to properly assess the relationship of the genera with 'leucobryoid leaves'.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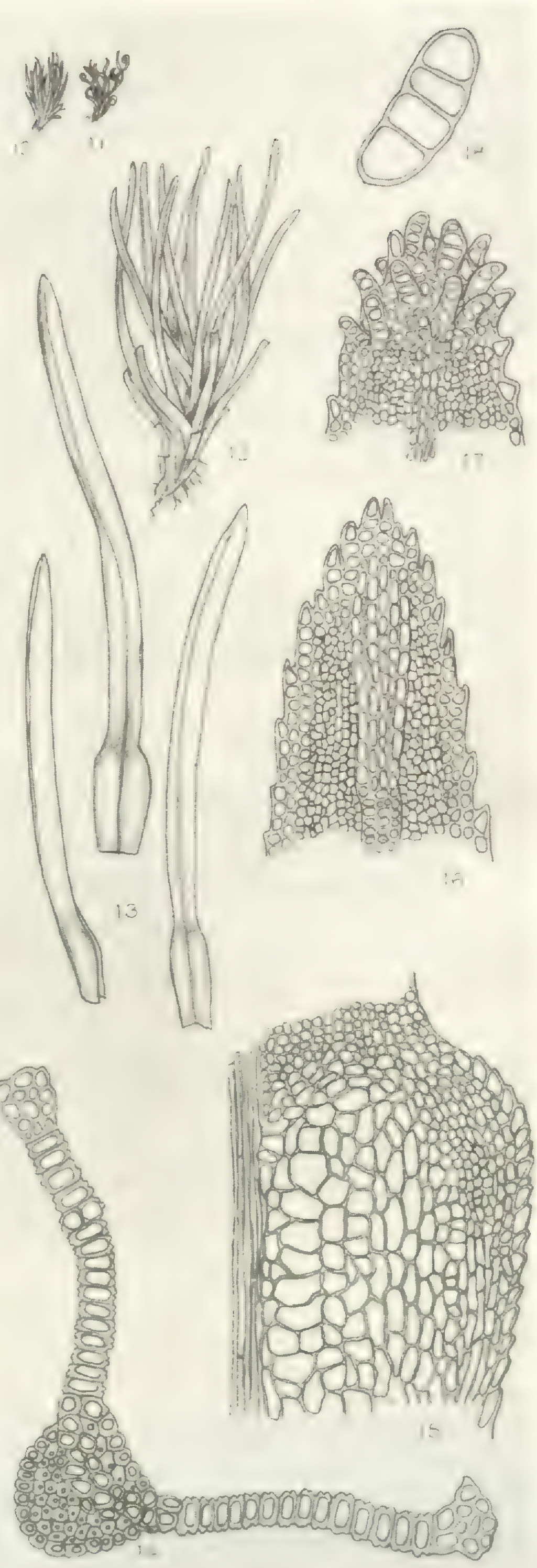
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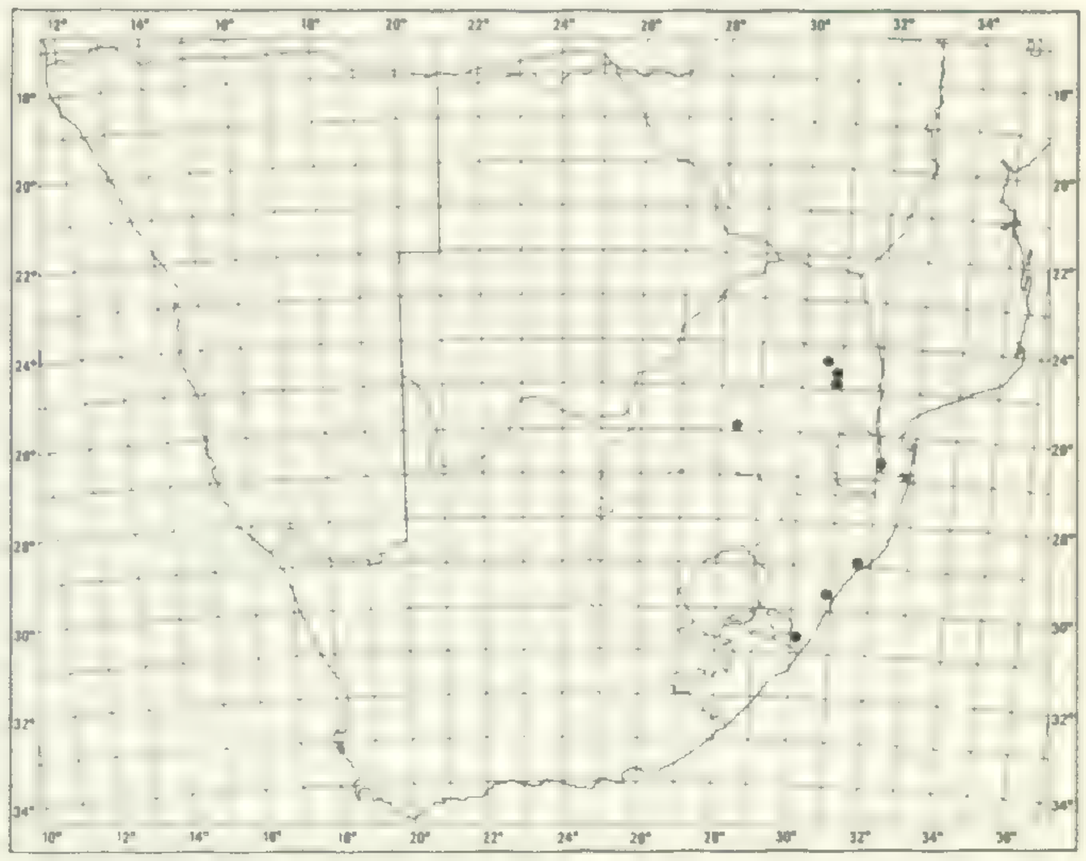
Octoblepharum albidum *Hedw.*, Spec. Musc. 50 (1801); Broth. in Natürl. PflFam. 10: 226 (1924); Sim, Bryo. S. Afr. 183 (1926). Type: Bahamas.

Plants small to medium, loosely caespitose, glaucous-green; corticolous. *Stems* 2–4 mm high, unbranched; in section round, central strand absent, cortical cells large, in 5 rows, outer row slightly thickened. *Leaves* squarrose above base wet or dry, oblong above a wider, oval base, 4–5 mm long; apex rounded, abruptly apiculate; margins plane, entire or serrulate at apex. *Costa* filling upper leaf; in distal section reniform, chlorocysts small, triangular, ventral leucocysts in 3 layers, dorsal leucocysts in 2 layers. *Laminal cells* quadrate; basal cells rectangular; leucocysts thin-walled, with large lateral pores. *Gemmae* or rhizoidal growth frequent at leaf apices, gemmae clavate, 4–6 cells long.

Autoicous. Perigonia scattered along stem; perichaetia terminal, leaves undifferentiated. *Seta* 3–4 mm long, straight; capsule small, erect, urn ovoid, ± 1 mm long, symmetrical; peristome short, teeth 8, triangular, 0,1–0,2 mm long, yellow-brown; operculum rostrate, beak oblique; calyptra cucullate, deciduous; spores round, 17–20 μm, granulose. Fig. 44: 1–9.

Octoblepharum albidum is widespread in the Americas, Africa and Australasia. In Southern Africa the species is rarely collected at the base of trees or on thick humus in closed forests of the central and eastern Transvaal, Swaziland, Zululand and Natal. Map 60.



MAP 60.— ● **Octoblepharum albidum**
× **Calymperes rabenhorstii**

Vouchers: *Kemp* 808; *Schelpe* PRE-CH12638; *Wager* PRE-CH444.

The species is easily identified by its thick, leathery, glaucous-green leaves and small size. The upper leaves are bent sharply back above the appressed base giving the plants a pressed or flattened appearance.

2. CALYMPERES

Calymperes *Sw.* in **Web., Tab.** Exh. Calyptr. Operc. Gen. (1813); Broth. in Natürl. PflFam. 10: 236 (1924); Sim, Bryo. S. Afr. 261 (1926); Edwards in J. Bryol. 11: 55 (1980). Lectotype species: *C. lonchophophyllum* Schwaegr., vide Williams in Bull. Torrey bot. Club 47: 385. (1920).

Plants dull, dark green, scattered or in tufts; corticolous. *Stems* short; central strand absent. *Leaves* linear above hyaline sheathing base; margins thickened; teniolae often present. *Costa* strong, percurrent to short-excurrent, frequently gemmiferous. *Laminal cells* small, cancellinae nearly filling base.

Perichaetia terminal. *Seta* short; capsule cylindrical; peristome absent; calyptra campanulate, plicate, ± twisted, persistent.

FIG. 44.—**Octoblepharum albidum** (1–9): **1.** habit, ×1; **2.** habit, ×5; **3.** leaves, ×12; **4.** leaf in proximal cross section, ×75; **5.** leaf in distal cross section, ×75; **6.** leaf cells at shoulder, ×130; **7.** upper leaf cells at margin, ×130; **8.** leaf apex, ×130; **9.** part of capsule mouth with peristome teeth and spores, ×110. **Calymperes levyanum** (10–18): **10.** habit, wet, ×1; **11.** habit, dry, ×1; **12.** habit, ×4; **13.** leaves, ×12; **14.** leaf in distal cross section, ×300; **15.** leaf cells at shoulder, ×125; **16.** leaf apex, ×125; **17.** leaf apex with gemmae, ×125; **18.** gemmae, ×400. (1–9, *Wager* 125; 10–18, *Crosby & Crosby* 10136).

A genus of approximately 250 species, *Calymperes* is most common in tropical regions, especially in Africa and southeast Asia. In Southern Africa the genus is very rare; the taxa were only recently reported from the Flora area.

1 Teniolae present, occasionally weak above.....1. *C. rabenhorstii*
1 Teniolae absent:
  2 Costa excurrent; gemmae produced in cluster all around tip of costa.....2. *C. tenerum* var. *edamense*
  2 Costa percurrent; gemmae produced on ventral costal surface.....3. *C. levyanum*

1. **Calymperes rabenhorstii** *Hampe & C. Müll.* in Flora, Jena 69: 512 (1886); Edwards in J. Bryol. 11: 62 (1980). Type: Guineae, Lagos, *Rabenhorst* s.n. (BM).

Plants small, in loose tufts, dark green; corticolous. *Stems* erect, irregularly branched; in section round, central strand absent, inner cortical cells in 4–5 rows, outer cortical cells in 1–2 rows, slightly smaller, brownish. *Leaves* contorted and exposing hyaline bases dry, erect-spreading wet; oblong to lingulate above obovate base, 2–3(4) mm long; apex rounded, apiculate; base sheathing; margins plane, serrate, strongly so at shoulders; teniolae present, occasionally weak above, in section forming intermarginal, multicellular knob; extrateniolar lamina 1–3 cells wide. *Costa* percurrent to just excurrent, ventral superficial cells quadrate to rectangular, smooth to weakly prorate above, dorsal superficial cells rectangular, sharply prorate; in section elliptical, stereids absent, guide cells 6–8, large, weakly thickened, ventral cells in 3–4 layers, smaller than guide cells, ventral surface cells slightly larger, mammillose, dorsal cells in 6–7 layers, cells in 3 rows under guide cells similar to ventral cells, 3–4 outer rows with cells smaller, flattened, incrassate, dorsal surface cells larger, sharply mammillose. *Laminal cells* small, rounded-quadrate, ventral surface strongly mammillose, dorsal surface weakly mammillose or papillose; single row of juxtacostal cells slightly larger; cancellinae rectangular; teniolar cells rectangular to long-rectangular, smooth.

Dioicous. Perichaetia terminal, leaves weakly differentiated, base somewhat longer. *Seta* 3–4 mm long, red-brown; capsule cylindrical, 2,0–2,5 mm long, yellow-brown; exothecial cells rectangular, weakly sinuolate, in zig-zaging rows, at mouth with 2 rows of quadrate cells and up to 7 rows of transversely rectangular cells below mouth; stomata present at base of urn, phaneropore; peristome absent; operculum long-rostrate, 0,7–1,2 mm long, cells not twisted; calyptra persistent, cylindrical-rostrate, clasping base of capsule, scabrous above, dehiscence of spores through longitudinal slits in upper calyptra; spores rounded, 15–25 μm, yellowish, smooth with scattered large granules. Fig. 45: 9–16.

Endemic to Africa, *C. rabenhorstii* is most commonly collected in west tropical Africa, however specimens have also been reported from Zaire and Angola. A single specimen, with sporophytes, is known from Southern Africa. The specimen was recently collected on Raphia palms at Kosi Bay, in north-eastern Zululand. Map 60.

Voucher: *Vahrmeijer* PRE-CH12930.

The species can be separated from the other Southern African taxa by the presence of teniolae; although they are rather weak on the only collection seen from the Flora area. The Southern African specimen did not have gemmae, but they are reported to occur in clusters at the leaf apex and are clavate with a long tapering apex (Edwards, 1980).

2. **Calymperes tenerum** *C. Müll.* var. **edamense** *Fleisch.*, Musci Fl. Buitenzorg 1: 275 (1904); Edwards in J. Bryol. 11: 83 (1980). Type: Java, Insel Edam, Musci Frond. Archipelagi Indici, ser. II, no. 63 (MANCH).

Calymperes nashii Williams in Bull. Torrey bot. Club 47: 391 (1920); Steere in Grout, Moss Fl. N. Amer. 1: 133 (1937). Type: Haiti, Port Margot, *Nash* 51 (NY).

Plants small, dark green to yellow-green, scattered or in small tufts; corticolous. *Stems* erect, 1–2 mm high, unbranched; in section without central strand, cortical cells large, thickened, becoming smaller toward margin. *Leaves* incurved or contorted dry, erect-spreading wet; oblong or occasionally weakly obovate, 2,0–2,8 mm long; apex acute to obtuse; base not broader than lamina; margins plane, entire, thickened above base, in section forming small knob of 3–5 round cells. *Costa* short-excurrent, with gemmiferous tip, dorsally spinulose above base; in section oval, guide cells 6,

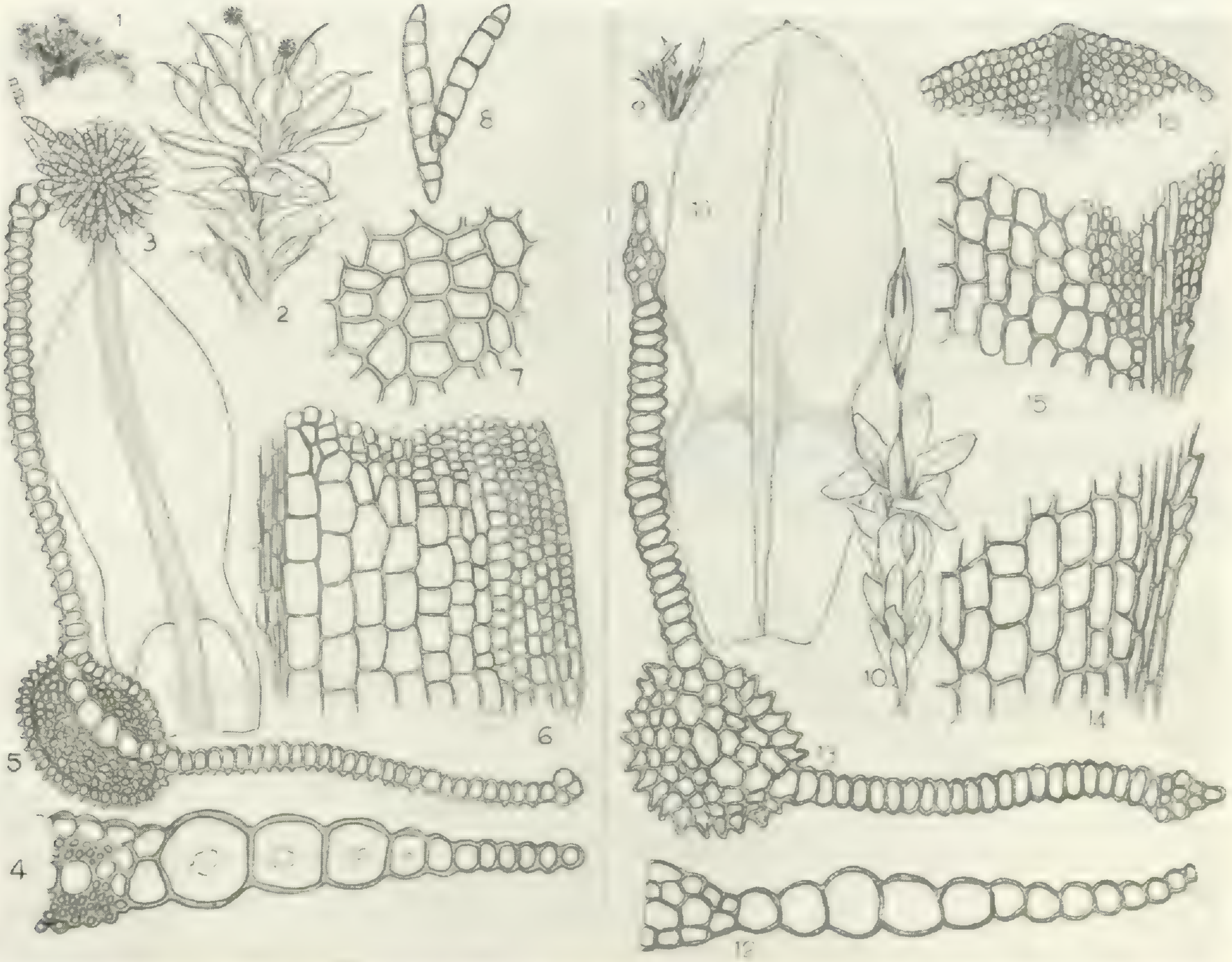
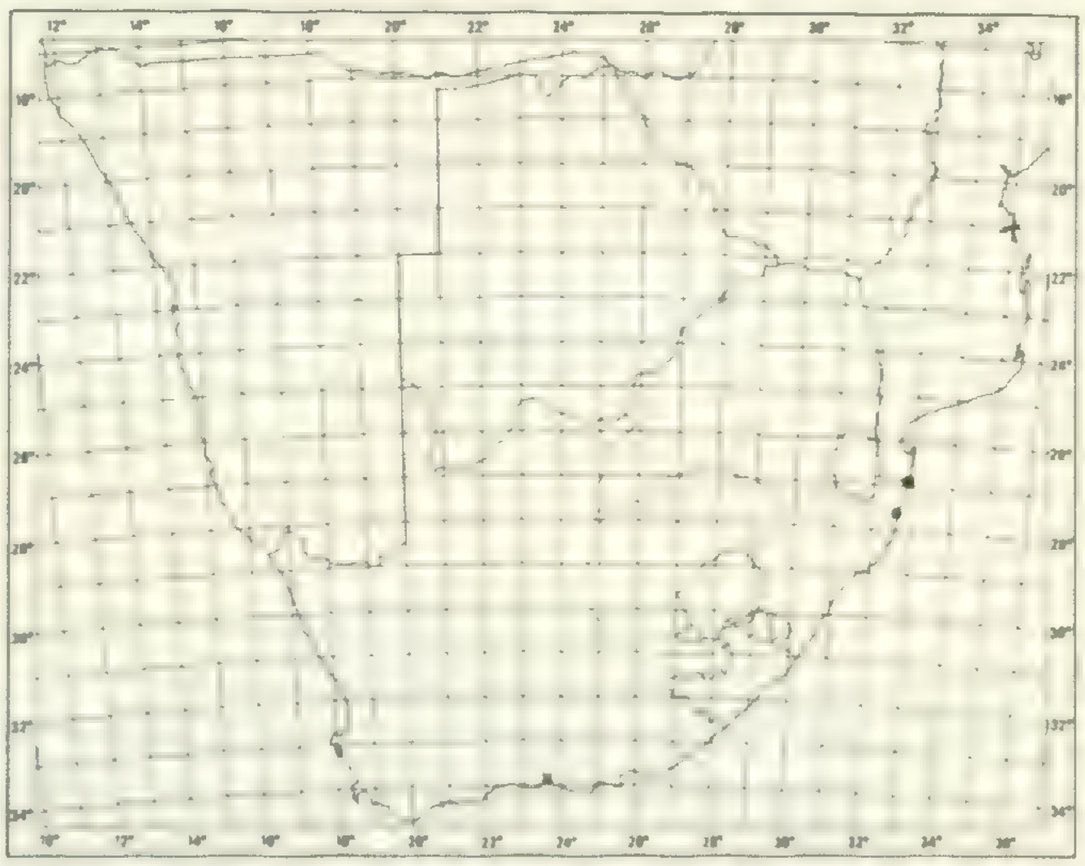


FIG. 45.—**Calymperes tenerum** var. **edamense** (1–8): **1.** habit, ×1; **2.** habit, ×10; **3.** leaf, ×25; **4.** leaf in proximal cross section, ×170; **5.** leaf in distal cross section, ×170; **6.** junction of basal and laminal cells, ×170; **7.** upper laminal cells, ×640; **8.** gemmae, ×95. **C. rabenhorstii** (9–16): **9.** habit, ×1; **10.** habit, ×10; **11.** leaf, ×25; **12.** leaf in proximal cross section, ×170; **13.** leaf in distal cross section, ×170; **14.** cancellinae at lower right margin, ×170; **15.** junction of cancellinae and laminal cells at right leaf shoulder, showing teniola, ×170; **16.** cells at leaf apex, ×170. (1–8, *Magill* 5425; 9–16, *Vahrmeijer* PRE-CH12930).

ventral substereid band 5 cells thick, cells irregularly shaped, ventral surface cells slightly smaller than laminal cells, sharply mammillose, dorsal substereid band to 6 cells thick, cells irregularly shaped, dorsal surface cells round, sharply mammillose. *Upper laminal cells* quadrate to hexagonal, mammillose ventrally, weakly papillose dorsally; marginal cells quadrate, smooth, rectangular below; cancellinae rectangular; teniolae absent. *Gemmae* fusiform, in apical cluster on all sides of excurrent costa.



MAP 61.— ● **Calymperes tenerum** var. **edamense**
× **Calymperes levyanum**

Sporophyte not known from Africa. Fig. 45: 1–8.

New to Southern Africa, *C. tenerum* var. *edamense* has been collected in Java, west and east Africa, the West Indies, Mexico and southern Florida, U.S.A. The Southern African specimens were collected on trees along Ku-Nkanini Stream in northern Zululand and in coastal dune forest near Sodwana Bay. Map 61.

Vouchers: *Magill* 5400, 5425.

This species is similar to *C. victoriae* Dix., but differs in the excurrent costa, absence of teniolae and smaller size. See additional notes on *C. victoriae* under *C. levyanum*.

3. Calymperes levyanum *Besch.* in Annls Sci. nat. Bot., sér. 8, 1: 273 (1896); Broth. in Natürl. PflFam. 10: 241 (1924); Florschütz, Mosses of Suriname 121 (1964). Type: Nicaragua, *Levy* s.n. (NY, PC!).

Plants small, in loose tufts, dark green; corticolous. *Stems* 4–6 mm high, occasionally branched; in section round, central strand absent, inner cortical cells in 5–6 rows, large, slightly thickened, yellowish, outer cortical cells in 1–2 rows, smaller, incrassate, reddish. *Leaves* curled dry, wide-spreading wet; linear, 5,5–6,0 mm long; apex acute; base elongate, to 1,5 mm long, abruptly constricted to linear lamina; margins dentate above, with multicellular teeth, serrate at shoulders by projecting cells; in section thickened above base, forming round or quadrate knob, 4–5 cells thick, inner cells incrassate, round. *Costa* percurrent, gemmiferous at apex; in section wedge-shaped, guide cells 4–8, indistinct, ventral cells in 2–3 layers, incrassate, dorsal stereid band 4–5 cells thick, dorsal surface cells substereids. *Upper laminal cells* rounded, quadrate to transversely short-rectangular, papillose with 4–6 low, blunt papillae over lumen; marginal cells quadrate, slightly larger, smooth; basal marginal cells rectangular; cancellinae quadrate, teniolae absent. *Gemmae* clavate, produced on ventral costal surface at apex.

Sporophyte not known in Africa. Fig. 44: 10–18.

New to Africa, *C. levyanum* was previously known from Central America, West Indies and northern South America. The new record was collected on a rotting log in wet forest at Bloukrans Pass in the southern Cape, at an elevation of 200 m. Map 61.

Voucher: *Crosby & Crosby* 10136.

Calymperes victoriae Dix. from the Victoria Falls, Zimbabwe, is similar but differs from this species by its oblong leaves that abruptly constrict to a short, spathulate, gemmiferous tip. The costa in section has dorsal and ventral stereid bands and incrassate surface cells. The leaves also have narrow teniolae extending from the leaf base to the thickened margin. Both species grow on wood or bark in moist environments.

3. SYRRHOPODON

Syrrhopodon *Schwaegr.*, Spec. Musc. Suppl. 2: 110 (1824); Broth. in Natürl. PflFam. 10: 299 (1924); Sim, Bryo. S. Afr. 261 (1926). Lectotype species: *S. gardneri* (Hook.) Schwaegr., vide Britt. in Britt., Fl. Bermuda 436 (1916).

Plants dark green with conspicuous hyaline leaf bases, loosely caespitose or in small tufts; corticolous, saxicolous or terricolous. *Stems* 2–20 mm long; central strand absent. *Leaves* spirally twisted or curled dry, exposing bright hyaline sheathing bases; margins thickened or with hyaline, cartilaginous border, strongly dentate to smooth. *Laminal cells* small, papillose or sharply mammillose; cancellinae nearly filling base.

Perichaetia terminal. *Seta* erect; capsule immersed or exserted, ovoid to cylindrical; peristome teeth 16 or absent; operculum rostrate; calyptra cucullate, smooth, deciduous.

Syrrhopodon is a genus of 270 species concentrated in the Tropics. The genus is well represented in the Southern Hemisphere and extends northward into North America, but is absent from Europe and northern Asia.

1 Leaves strongly toothed above, spinose at shoulders ..... 1. *S. gomesii*
1 Leaves weakly serrate along hyaline border:
  2 Leaf margins smooth below; margins of perichaetial leaves ± smooth ..... 2. *S. uncinifolius*
  2 Leaf margins frequently denticulate at shoulders; margins of perichaetial leaves sharply toothed at shoulders ..... 3. *S. obliquirostris*

1. **Syrrhopodon gomesii** *P. Varde* in Svensk bot. Tidskr. 42: 253 (1948). Type: Mozambique, Namuli Mts, *Gomes & Sousa* 3491, p.p. (PC!).

Plants medium-sized, dark green, scattered or in small groups; corticolous. *Stems* 5–12 mm high; in section round, central strand absent, inner cortical cells in 6–8 rows, large, yellowish, outer cortical cells in 1–3 rows, stereids to substereids, reddish. *Leaves* inrolled or curved dry, spreading wet; linear above obovate base, 4,5–5,0 mm long; apex acute or rounded in gemmiferous leaves; margins thickened above shoulders, irregularly dentate with intermittent groups of larger teeth, spinose at shoulders. *Costa* percurrent; in section subround, guide cells 4, large, ventral stereid band 2–3 cells thick, ventral surface cells large, incrassate, sharply mammillose, dorsal stereid band 4–5 cells thick, dorsal surface cells incrassate, sharply mammillose. *Upper laminal cells* quadrate to hexagonal, extending down leaf between cancellinae and border, sharply papillose or papillae sometimes bifid; cancellinae quadrate above, rectangular below; basal marginal cells in 3–4 rows, linear, smooth.

Sporophyte not known. Fig. 46: 22–29.

New to Southern Africa, *S. gomesii* was described from the Namuli Mountains of Mozambique (1537 AC). Two recent collections have been made on wood in mountain forests of the northeastern Transvaal. Map 62.

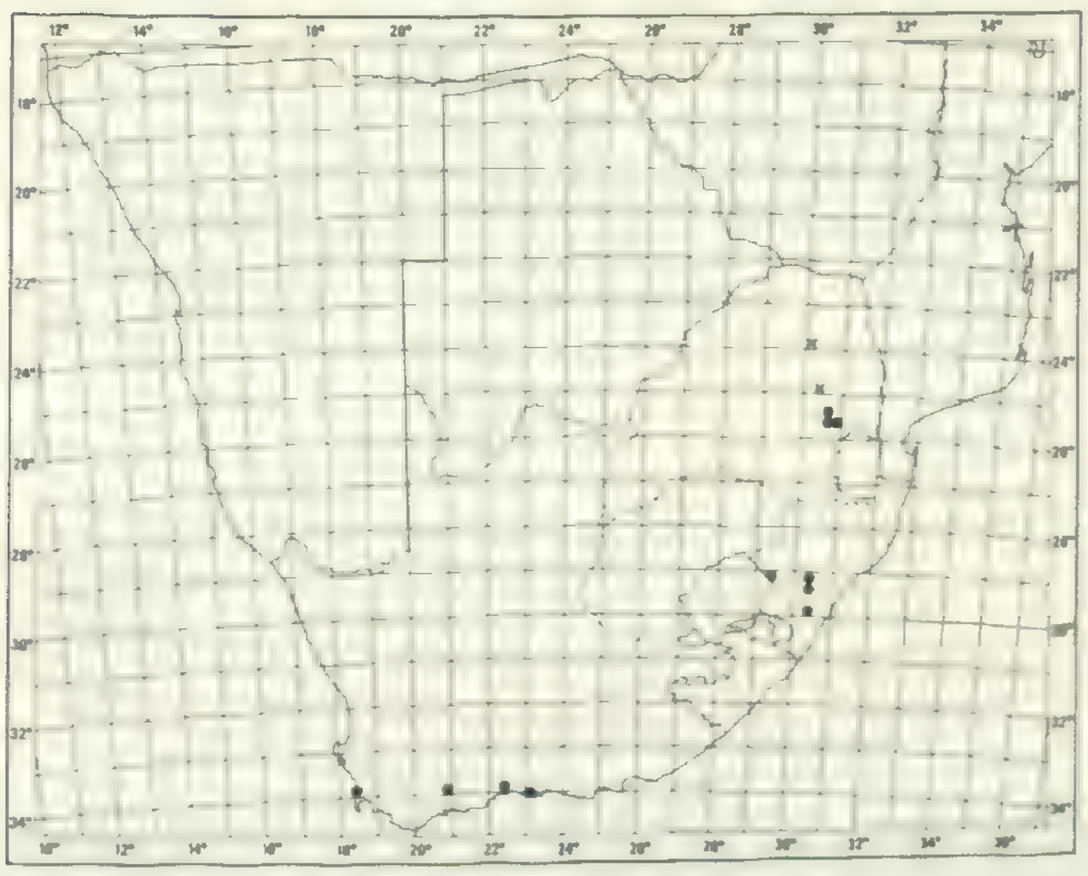
Vouchers: *Crosby & Crosby* 7552; *Smook & Phelan* 865.

Syrrhopodon gomesii is distinct from other Southern African species of the genus by its strongly dentate and spinose leaves and less obvious hyaline leaf base. The plants grow on tree trunks and wood in dense indigenous forests.

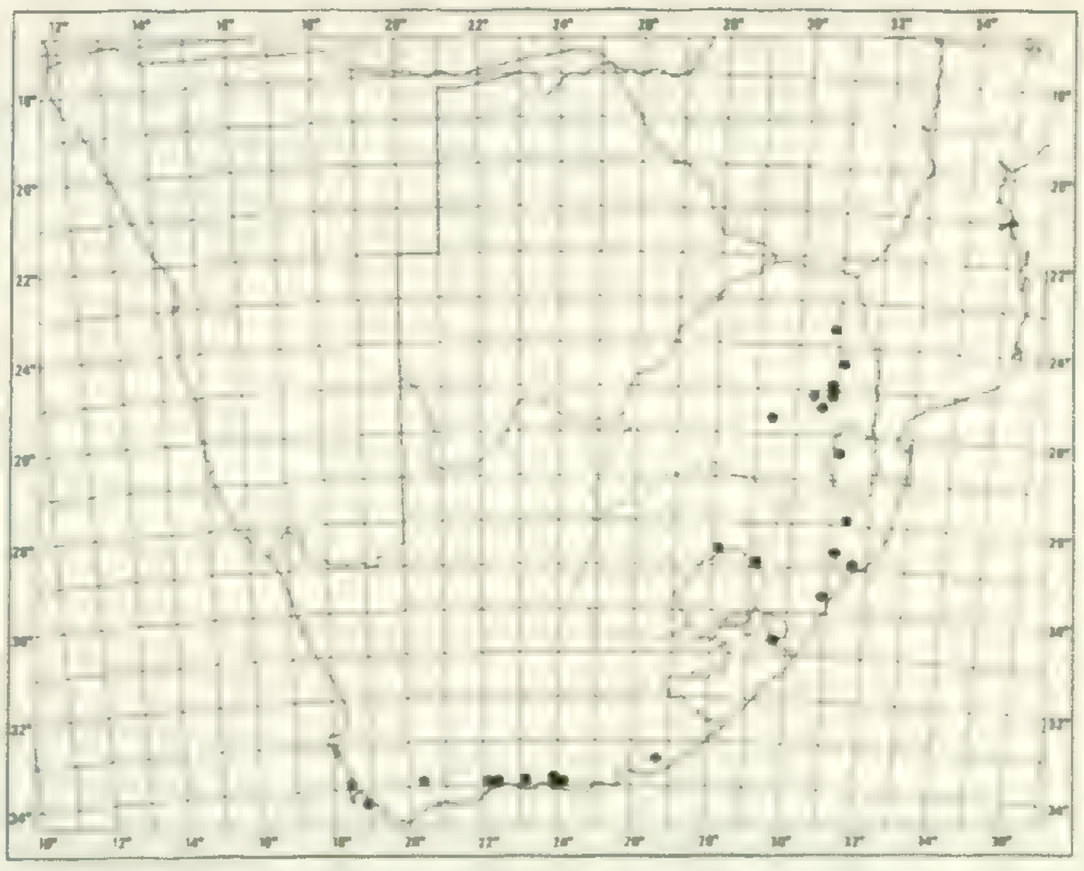
2. **Syrrhopodon uncinifolius** *C. Müll.* in Hedwigia 38: 96 (1899); Broth. in Natürl. PflFam. 10: 231 (1924); Sim, Bryo. S. Afr. 263 (1926); Dix. in Trans. R. Soc. S. Afr. 8: 189 (1920). Type: Cape, Montagu Pass, *Rehmann* 129 (BOL!; PRE!).

Syrrhopodon erectifolius C. Müll. in Hedwigia 38: 96 (1899). Syntypes: Cape, Montagu Pass, *Rehmann* 128 (BOL!; NH!), 129 (NH!); Orange Free State, Kadziberg, *Rehmann* s.n.

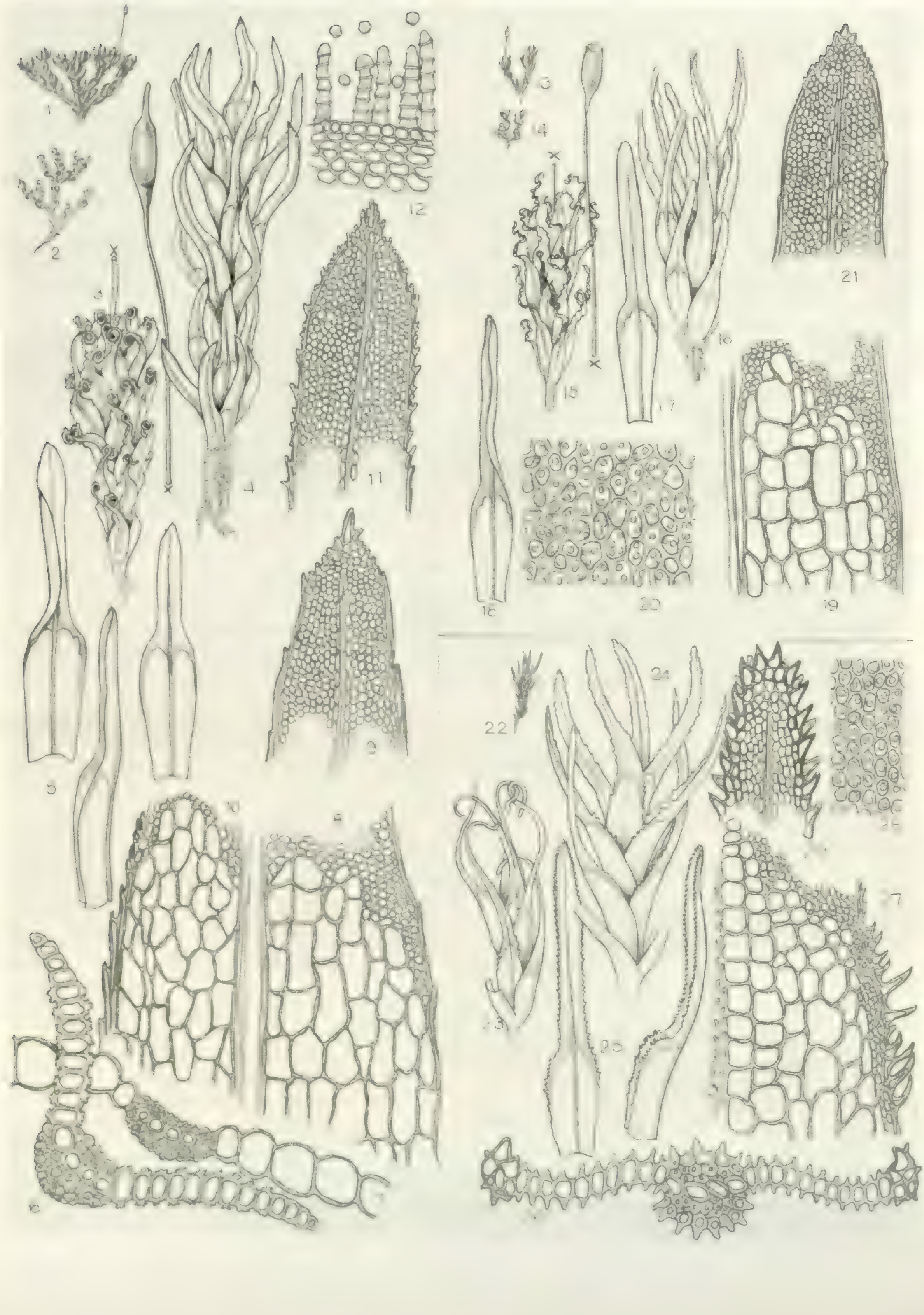
Plants small to medium, loosely caespitose, dark green with conspicuous hyaline leaf bases; terricolous, saxicolous or corticolous. *Stems* 5–10 mm high, unbranched; in section round, central strand absent, cortical cells large, in 8 rows, somewhat smaller toward margin. *Leaves* spirally twisted or tightly inrolled above sheathing, hyaline base dry, erect-spreading wet; ligulate above obovate base, 2,5–4,0 mm long; apex acute; margins plane to undulate, entire below, serrate to toothed at apex, border of linear, hyaline cells from base to just below apex, cartilaginous. *Costa* percurrent to mucronate; in section elliptical to wedge-shaped, guide cells 4, incrassate, ventral stereid band 2 cells thick, infrequently substereids, exposed, dorsal stereid band 2–3 cells thick, dorsal surface cells undifferentiated, smooth. *Upper laminal cells* quadrate, extending down



MAP 62.— ● **Syrrhopodon obliquirostris**
× **Syrrhopodon gomesii**



MAP 63.— ● **Syrrhopodon uncinifolius**



leaf between cancellinae and border, cells with 4–6 low, blunt papillae; cancellinae rectangular to quadrate. *Gemmae* clavate, 4–5 cells long, produced on ventral costal surface at apex.

Perichaetia terminal; leaves ligulate above long-sheathing base, margins smooth throughout. *Seta* to 5 mm long, light brown; capsule short-cylindrical, to 1 mm long, light brown; peristome fragile, teeth vertically striate; operculum long-rostrate, beak ± oblique; calyptra cucullate; spores round, 17–18 μm, granulose. Fig. 46: 13–21.

Endemic to Southern Africa, *S. uncinifolius* has been collected in forests of the southwestern, southern and eastern Cape, Natal, eastern Orange Free State, Swaziland and the central, eastern and northern Transvaal. Map 63.

Vouchers: *Crosby & Crosby* 8007; *Kemp* 1057; *Von Breitenbach* 405.

This species is identified by its spirally twisted, dark green upper leaf lamina and obvious, sheathing, hyaline bases. It is not easily separated from *S. obliquirostris* without fruiting material; see note under that species.

3. **Syrrhopodon obliquirostris** *C. Müll.*, Syn. Musc. 1: 543 (1849); Broth. in Natürl. PflFam. 10: 231 (1924); Sim, Bryo. S. Afr. 263 (1926); Dix. in Trans. R. Soc. S. Afr. 8: 189 (1920). Type: Cape, Grootvaderbosch, *Ecklon* s.n.

Plants small, loosely caespitose, dark green with conspicuous hyaline leaf bases; corticolous. *Stems* 5–10 mm tall; in section round, central strand absent, cortical cells in 4–6 rows, large, thin-walled. *Leaves* inrolled or curled dry, spreading wet; lingulate above obovate base, 2,5–3,0 mm long; apex broadly acute; margins plane, entire to weakly serrate, toothed at apex, occasionally a few teeth at shoulders; bordered by elongate, hyaline cells, extending from base to near apex, cartilaginous. *Costa* percurrent, toothed dorsally at apex; in section sub-elliptical, guide cells 4, incrassate, ventral stereid band 2 cells thick, exposed, dorsal stereid band 3–4 cells thick, dorsal surface cells not differentiated, smooth. *Upper laminal cells* quadrate, only slightly extended down leaf between cancellinae and border, cells with 4–6 low, blunt papillae; cancellinae rectangular to quadrate. *Gemmae* clavate, 4–5 cells long, frequent, produced ventrally at leaf apex.

Perichaetia terminal, leaves linear above long, sheathing base; margins sharply toothed at shoulders, frequently with smaller teeth along upper margin. *Seta* to 4 mm long; capsule short-cylindrical, 1,5 mm long; peristome teeth linear, 0,1 mm long, whitish, blunt apically, vertically striate; operculum rostrate, beak oblique; calyptra cucullate; spores round, 17–18 μm, granulate. Fig. 46: 1–12.

Endemic to Southern Africa, *S. obliquirostris* is infrequently collected. The species occurs on bark or rotting wood in forests of the southwestern and southern Cape, Natal and eastern Transvaal. Map 62.

Vouchers: *Sim* 8728, 9122; *Wager* 288.

This species is very closely related to *S. uncinifolius* and may only represent a form of that species. A specimen that could be definitely considered type material has not been located; however, the Wager specimen cited above was identified by Dixon with the indication 'agrees well with specimens in the British Museum Collection', presumably the Ecklon collection. The sharply toothed perichaetial leaves separate specimens from *S. uncinifolius* and they are provisionally placed here, although Müller (1849) does not describe this character. The leaf bases of *S. obliquirostris* are described as '*obsolete denticulata*', a character observed on the Wager specimen and other collections.

FIG. 46.—**Syrrhopodon obliquirostris** (1–12): **1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, dry, ×10; **4.** habit, wet, ×10; **5.** leaves, ×12; **6.** leaf in distal cross section, ×250; **7.** leaf in proximal cross section, ×250; **8.** right half of lamina at junction of cancellinae and laminal cells showing margin, ×120; **9.** leaf apex, ×120; **10.** left half of perichaetial leaf lamina at junction of cancellinae and laminal cells showing margin, ×120; **11.** perichaetial leaf apex, ×120; **12.** part of capsule mouth with peristome teeth and spores, ×170. **S. uncinifolius** (13–21): **13.** habit, wet, ×1; **14.** habit, dry, ×1; **15.** habit, dry, ×10; **16.** habit, wet, ×10; **17–18.** leaves, ×12; **19.** right side of lamina at junction of cancellinae and laminal cells showing margin, ×120; **20.** upper laminal cells, ×350; **21.** leaf apex, ×120. **S. gomesii** (22–29): **22.** habit, ×1; **23.** habit, dry, ×10; **24.** habit, wet, ×10; **25.** leaves, ×12; **26.** leaf in distal cross section, ×300; **27.** right half of lamina at junction of cancellinae and laminal cells showing margin, ×120; **28.** upper laminal cells, ×350; **29.** leaf apex, ×120. (1–12, *Wager* 198; 13–21, *Crosby & Crosby* 8007; 22–29, *Crosby & Crosby* 7552).

4. HYPODONTIUM

Hypodontium *C. Müll.* in Hedwigia 38: 96 (1899); Broth. in Natürl. PflFam. 10: 234 (1924). Lectotype species: *Hypodontium dregei* (Hornsch.) C. Müll. (selected here).

Plants large, caespitose, glaucous-green to yellow-green; terricolous or saxicolous. *Stems* erect, 20–30 mm tall; central strand present. *Leaves* incurled dry, spreading wet, linear to lingulate above clasping base; margins unistratose, weakly bordered to mid-leaf or above, involute above mid-leaf or only at apex. *Costa* strong, with dorsal and ventral stereid band, ventral surface cells strongly differentiated.

Perichaetia terminal, leaves subulate, sheathing seta; capsule oval to short-cylindrical; peristome teeth 16, triangular, occasionally with weak properistomal thickenings; operculum rostrate; calyptra cucullate; spores large.

The genus *Hypodontium* contains two species, both known only from forests and woodlands of Zimbabwe and the eastern and southern parts of the Flora area.

1 Leaf margins generally involute from mid-leaf to apex; dorsal junction of lamina and costa with large spines above base; laminal cells with massive papillae; hyaline leaf border rarely reaching mid-leaf, if so, then disappearing in involute margins..... 1. *H. dregei*

1 Leaf margins plane or only involute at apex; dorsal costal surface smooth above, papillose below; leaf cells with low, stout papillae, occasionally larger; hyaline leaf border extending to near apex..... 2. *H. pomiforme*

1. **Hypodontium dregei** (*Hornsch.*) *C. Müll.* in Hedwigia 38: 97 (1899); Broth. in Natürl. PflFam. 10: 234 (1924). Syntypes: Cape, Zwart-kei, Windvogelberg, *Drège* s.n., 22 Nov.; Table Mountain, *Ecklon* s.n. (BM!).

Syrrhopodon dregei Hornsch. in Linnaea 15: 116 (1841); Sim, Bryo. S. Afr. 263 (1926).

Syrrhopodon perichaetialis Bruch ex Krauss in Flora, Jena 29: 132 (1846). Type: Cape, Uitenhage, Winterhoek, *Krauss* s.n. (BM!).

Trichostomum cyathiforme Dix. in S. Afr. J. Sci. 18: 310 (1922). *Hyophila cyathiforme* (Dix.) Sim, Bryo. S. Afr. 221 (1926). Type: Zimbabwe, Victoria Falls, *Sim* 8934 (BM, holo.!; PRE!).

Plants medium to large, forming dense cushions, glaucous-green to olive-green; saxicolous or corticolous. *Stems* 10–30 mm tall, frequently weakly tomentose; in section round, central strand small, weak, inner cortical cells in 4–5 rows, large, thickened, yellowish red, outer cortical cells in 1–2 rows, substereids or incrassate, reddish. *Leaves* contorted dry, erect-spreading wet; narrowly lingulate above oval, hyaline base, 4–5 mm long; apex acute; margins entire, involute above mid-leaf, plane below, narrow border of elongate, hyaline cells ending below involute portion of margin or infrequently extending into involute region, 2–6 cells wide in base, 1–2 cells wide at mid-leaf. *Costa* mucronate, ventral surface flat or convex; in section subround, guide cells 4–6, large, ventral stereid band 2–3 cells thick, occasionally substereids, ventral surface cells large, incrassate, strongly papillose, dorsal stereid band strong, 5–6 cells thick, dorsal surface cells incrassate, smooth, cells near junction of costa and lamina strongly papillose or spinose. *Upper laminal cells* quadrate, ventral surface with long, massive, bifid papillae, to 18 μm tall, dorsal surface with low, blunt papillae; marginal cells in involute region smooth; basal cells rectangular, hyaline, weakly papillose in upper base, smooth below.

Perichaetia terminal, leaves highly differentiated, subulate above long-sheathing base, 5–6 mm long, apices frequently reaching capsule base. *Seta* erect, 5–6 mm long, yellowish; capsule short-cylindrical, 1,6–2,0 mm long, yellow-brown; peristome teeth 16, triangular, 0,25 mm long, smooth, red-yellow, frequently with weak properistomal thickenings; operculum rostrate, 1 mm long; calyptra cucullate, 3 mm long; spores round, 35–45 μm, irregularly granulate. Fig. 47: 10–17.

Hypodontium dregei is presently known from Zimbabwe and Southern Africa. It is frequently collected on rock, shallow soil over rock or on trees, in forests and woodlands of the eastern and southern Flora area. Map 64.

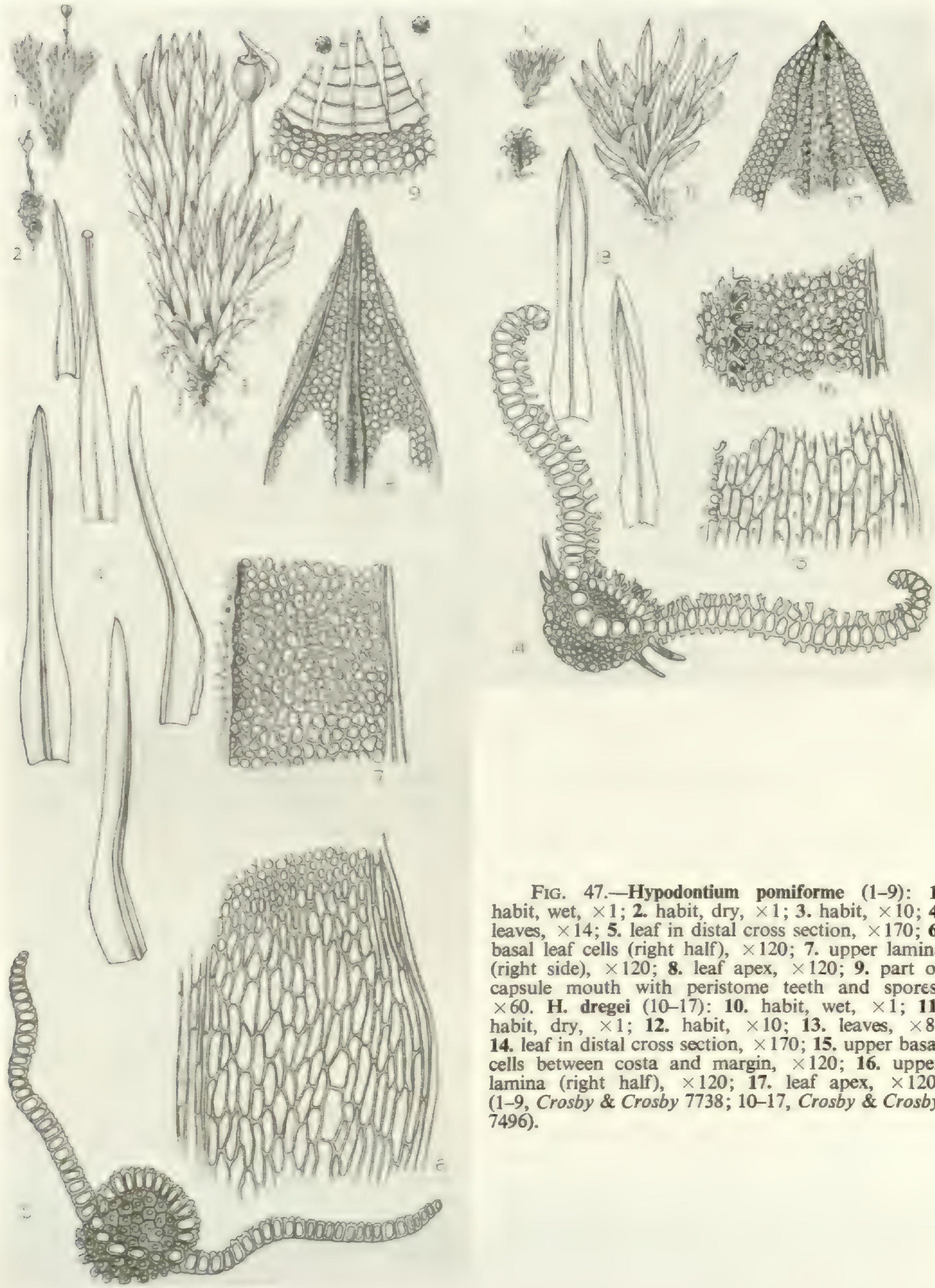
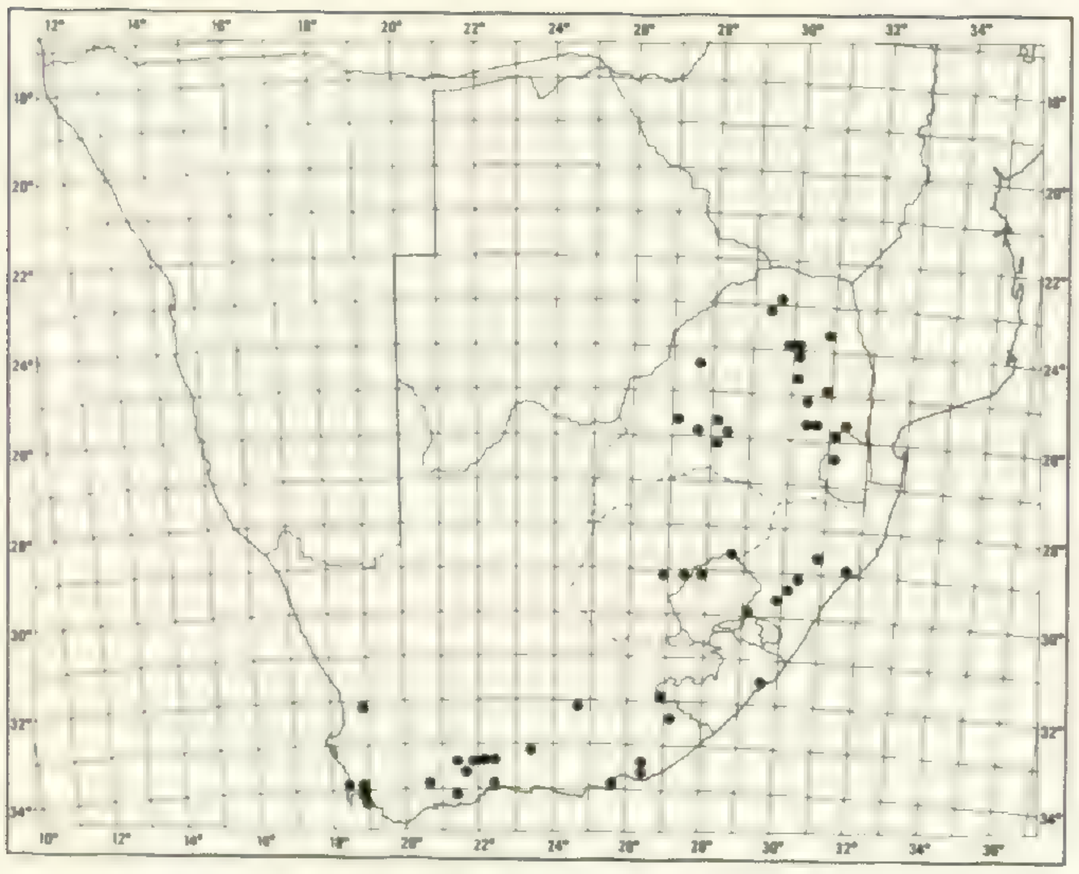
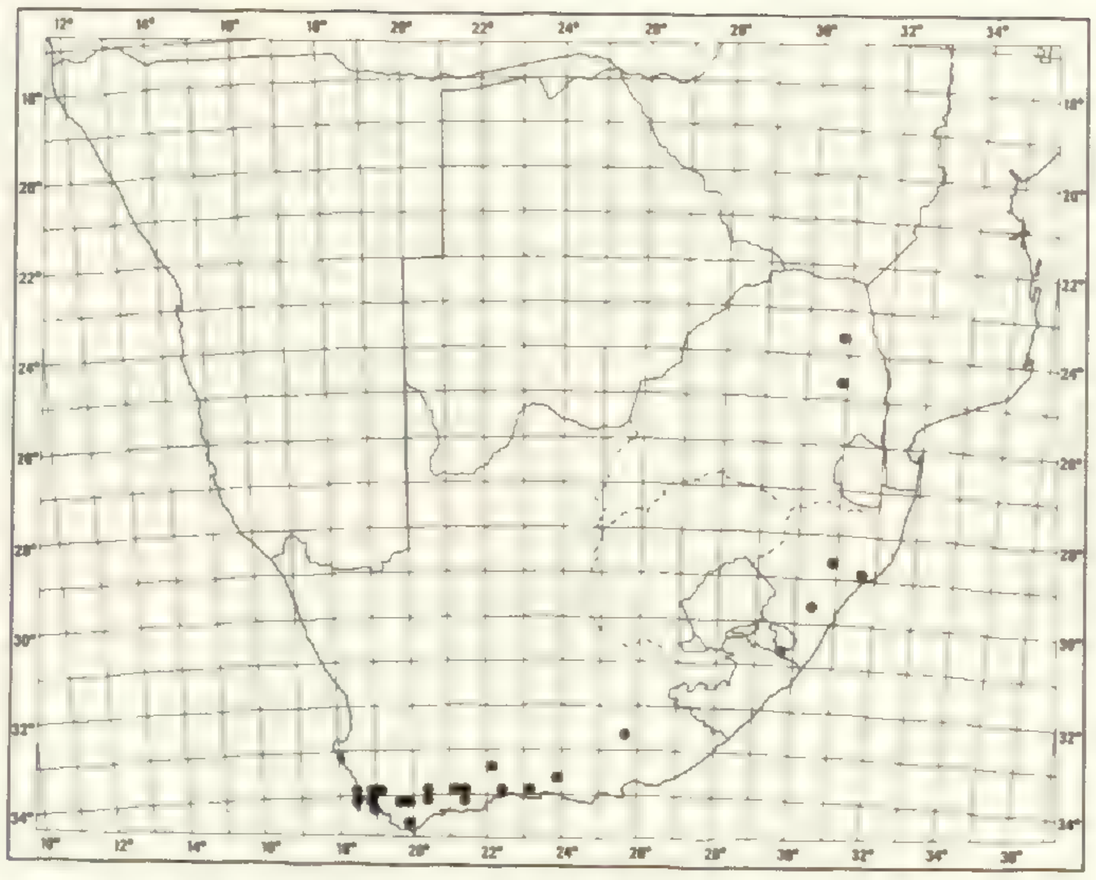


FIG. 47.—**Hypodontium pomiforme** (1–9): **1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, ×10; **4.** leaves, ×14; **5.** leaf in distal cross section, ×170; **6.** basal leaf cells (right half), ×120; **7.** upper lamina (right side), ×120; **8.** leaf apex, ×120; **9.** part of capsule mouth with peristome teeth and spores, ×60. **H. dregei** (10–17): **10.** habit, wet, ×1; **11.** habit, dry, ×1; **12.** habit, ×10; **13.** leaves, ×8; **14.** leaf in distal cross section, ×170; **15.** upper basal cells between costa and margin, ×120; **16.** upper lamina (right half), ×120; **17.** leaf apex, ×120. (1–9, *Crosby & Crosby* 7738; 10–17, *Crosby & Crosby* 7496).



MAP 64.— ● **Hypodontium dregei**



MAP 65.— ● **Hypodontium pomiforme**

Vouchers: *Brenan* M2753; *Cholnoky* 640a; *Crosby & Crosby* 7496; *Magill* 3525, 4314; *Smook* 1036; *Thompson* 3571; *Von Breitenbach* 137.

Vegetatively the species could be confused with some pottiaceous genera, however the massive ventral leaf cell papillae, and distinct border in the lower leaf should separate this species. In addition, when dry the plants have a very distinctive appearance produced by the contorted upper lamina and conspicuous sheathing, hyaline bases.

2. **Hypodontium pomiforme** (*Hook.*) *C. Müll.* in Hedwigia 38: 97 (1899); Broth. in Natürl. PflFam. 10: 234 (1924). Type: Cape, Swellendam, *Burchell* s.n. (BM, holo.!).

Weissia pomiformis Hook., Musc. Exot. 131 (1819). *Syrrhopodon pomiformis* (Hook.) Hampe ex C. Müll., Syn. Musc. 1: 531 (1849); Sim, Bryo. S. Afr. 262 (1926).

Hypodontium pomiforme var. *macowanianum* C. Müll. in Hedwigia 38: 97 (1899). Type: Cape, Boschberg, *MacOwan* 9 (GRA!; MANCH!).

Plants medium to large, in cushions, green to yellow-green; saxicolous or corticolous. *Stems* 20–50 mm tall, branched below, frequently densely tomentose; in section round, central strand small, inner cortical cells in 5–6 rows, large, outer cortical cells in 1–2 rows, small, incrassate, reddish. *Leaves* crisped above base dry, erect-spreading wet, linear above obovate base, 3–4 mm long; apex acute; margins entire, plane or involute at apex, narrow border of elongate, hyaline cells extending from base to near apex, rarely ending well below apex. *Costa* percurrent, ventral surface strongly convex; in section subround, guide cells 4–6, ventral stereid or substereid band in 3–4 layers, ventral surface cells large, with numerous small papillae, dorsal stereid band 3 cells thick, dorsal surface cells not differentiated, proximally with massive, low, blunt or bifid papillae, smooth distally. *Upper laminal cells* rounded, quadrate, incrassate, ventrally with 2–4 low, C-shaped papillae per lumen, occasionally papillae larger, bifid, dorsally weakly papillose to smooth; basal cells rectangular to elongate-hexagonal, hyaline, smooth.

Perichaetia terminal, leaves highly differentiated, linear-lanceolate above sheathing base, 4–6 mm long. *Seta* to 8 mm long; capsule oval, 2 mm long; peristome teeth 16, triangular, smooth, reddish yellow; operculum long-rostrate; calyptra cucullate; spores round, 45–50 μm, tuberculate. Fig. 47: 1–9.

Endemic to Southern Africa, *H. pomiforme* is infrequently collected in forests of the southwestern and southern Cape. It has also been occasionally collected in the eastern Cape, Transkei, Natal, Zululand and eastern Transvaal. Map 65.

Vouchers: *Boucher* 3662; *Crosby & Crosby* 7738, 8170; *Esterhuysen* 20109; *Taylor* 9626.

Hypodontium pomiforme is a large, stout, yellow-green plant growing on rock or rarely on bark, while by comparison *H. dregei* is smaller, dark green to glaucous-green and frequently collected on bark.

These characters, as well as those cited in the key, will generally separate the species. However, all these characters exhibit some variability and a few specimens have been difficult to place. These specimens can be identified using costal anatomy. The costa of *H. pomiforme*, in cross section, is strongly convex ventrally, while the costa of *H. dregei* is flat to weakly convex ventrally but very prominent dorsally.

ENCALYPTACEAE

Plants medium to large, forming large tufts, green to dark green; terricolous or saxicolous. *Stems* branched above, radiculose below; central strand present or absent. *Leaves* little altered dry, larger above; oblong, elliptical or spathulate; apex broadly rounded to short-acuminate, occasionally cucullate; margins plane or weakly revolute, entire or papillose. *Costa* ending below apex to excurrent; in section with dorsal stereid band. *Upper laminal cells* quadrate to hexagonal or irregular, slightly thickened, strongly papillose with large C- or O-shaped papillae; basal cells fragile, rectangular, longitudinal walls thin, end wall thickened, reddish; basal marginal cells narrow, thickened, forming distinct border.

Autoicous or dioicous. Perichaetia terminal on stems or branches, leaves frequently smaller. *Seta* erect; capsule cylindrical, smooth or furrowed dry; exothecial cells rectangular, quadrate at mouth; stomata scattered on lower urn; peristome single, double or absent, teeth 16, lanceolate to linear, prostome occasionally present; operculum deciduous with calyptra, long-rostrate; calyptra large, cylindrical-rostrate, smooth or scabrous, completely covering capsule, base entire, erose, lacerate or fringed; spores large, frequently ornate.

A family with two genera; only one, *Encalypta,* occurs in Southern Africa.

ENCALYPTA

Encalypta *Hedw.,* Spec. Musc. 60 (1801); Broth. in Natürl. PflFam. 10: 241 (1924); Sim, Bryo. S. Afr. 264 (1926); Flowers ex Grout, Moss Fl. N. Amer. 1: 137 (1938); Smith, Moss Fl. Brit. Irel. 206 (1978). Type species: not designated.

With characters of the family.

The genus *Encalypta* contains c. 35 species. The species are frequently widely distributed and found in temperate to arctic or alpine regions. The plants are gametophytically similar to several genera of Pottiaceae subfamily Pottioideae. The peristome, which can be single, double or absent, indicates that the family is a transition group between the Haplolepidae and Diplolepidae, with a status similar to that of Orthotrichaceae between the Acrocarpi and Pleurocarpi.

Two species are known from Southern Africa, both widespread in the Northern Hemisphere. Specimens almost always have sporophytes in some stage of development. The large calyptra characterizes the genus.

1 Calyptra fringed at base; spores smooth to papillose; leaves short-acuminate, costa short-excurrent . . . . . 1. *E. ciliata*

1 Calyptra entire to erose at base; spores warty distally; leaves acute to obtuse, somewhat cucullate, costa ending below apex or percurrent . . . . . 2. *E. vulgaris*

1. **Encalypta ciliata** *Hedw.,* Spec. Musc. 61 (1801); Broth. in Natürl. PflFam. 10: 242 (1924); Sim, Bryo. S. Afr. 264 (1926); Flowers ex Grout, Moss Fl. N. Amer. 1: 142 (1938); Smith, Moss Fl. Brit. Irel. 207 (1978). Type: Europe.

Plants medium to large, forming cushions, dark green; terricolous or saxicolous. *Stems* 5–20 mm tall, branching above, radiculose below; in section round, central strand medium-sized, inner cortical cells large, in 5–6 rows, thin-walled, outer cortical cells smaller, in 2 rows, incrassate, reddish. *Leaves* crowded above, weakly contorted dry, widespreading wet; lingulate to oblong or elliptical, 3–6 mm long; apex short-acuminate, base oblong; margins papillose, weakly recurved for a short distance just above base, plane distally. *Costa* very short-excurrent, ventral superficial cells quadrate, papillose, similar to laminal cells, dorsal superficial cells linear, smooth below, sharply prorate distally; in section subround, guide cells 4, large, with several dorsal supplementary cells, ventral cells in 2 rows, slightly thickened, ventral surface cells smaller, papillose, dorsal stereid band strong, in 2–4 rows, dorsal

surface cells not differentiated, smooth. *Upper laminal cells* hexagonal to subhexagonal, slightly thickened, papillae 2–6, large, C- or O-shaped; basal cells rectangular, fragile, vertical walls thin, end walls thickened, reddish; basal marginal cells linear, forming distinct border 2–4 cells wide.

Autoicous. Perichaetia terminal, leaves smaller, oval-acute, costa excurrent as short awn. *Seta* erect, 6–10 mm long, red-brown; capsules cylindrical, 2,5–3,0 mm long, yellowish; exothecial cells rectangular to linear, strongly thickened; peristome fragile, frequently missing on empty capsules, teeth lanceolate, occasionally perforated, 125 μm long, granulate; operculum long-rostrate, 1,6 mm long; calyptra cylindrical-rostrate, 4,5–5,0 mm long, base with strongly differentiated fringe of enlarged, rectangular cells; spores discoid, 36–38 μm, yellowish, tetrad scar obvious, distal surface smooth, granulate or occasionally with rounded papillae. Fig. 48: 1–12.

Encalypta ciliata is known from North, Central and South America, Europe, Asia and Africa. In Southern Africa, the species is occasionally collected on soil or rock in mountainous regions of the central Cape, Natal and Lesotho. Map 66.

Vouchers: *Hilliard & Burtt* 10502; *Magill* 4412, 4697, 5899.

Although the fringe at the calyptra base is fragile, as stated by Sim (1926), its detection was never a problem. In addition, *E. ciliata* and *E. vulgaris* can be separated by the shape of the leaf apex, costal length and spore ornamentation.

The peristome of *E. ciliata* is very fragile and has generally broken away by the time the capsule is empty; thus older specimens could be confused with *E. vulgaris*.

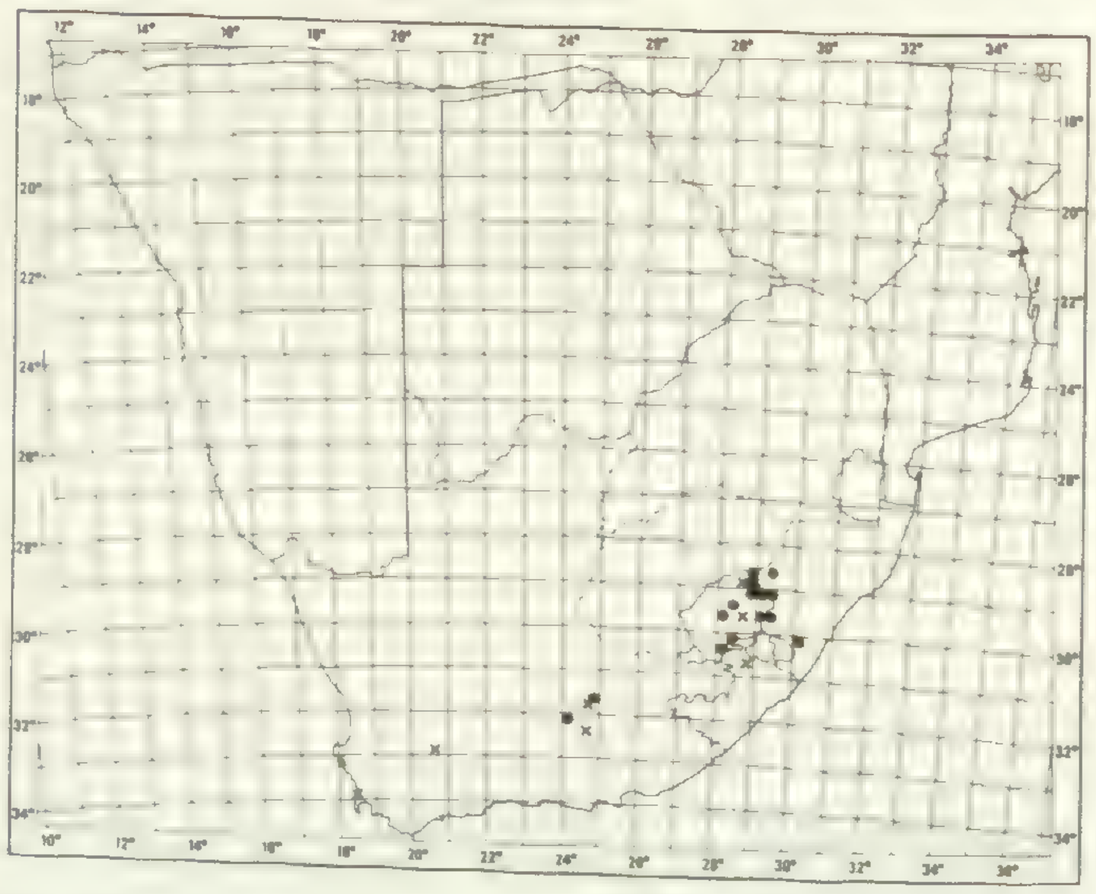
2. **Encalypta vulgaris** *Hedw.*, Spec. Musc. 60 (1801); Broth. in Natürl. PflFam. 10: 24 (1924); Flowers ex Grout, Moss Fl. N. Amer. 1: 139 (1938); Scott & Stone, Moss. S. Aust. 221 (1976); Smith, Moss Fl. Brit. Irel. 207 (1978). Type: Europe.

Plants medium-sized, forming cushions, green; saxicolous. *Stems* 5–20 mm, radiculose below; in section round, central strand present, inner cortical cells medium-sized, thin-walled, in 5–6 rows, outer cortical cells smaller, in 2 rows, reddish. *Leaves* erect with lamina inrolled dry, widespreading wet; lingulate to elliptical, 3–4 mm long; apex acute to mucronate, frequently cucullate; base oblong; margins plane, papillose. *Costa* ending below apex or percurrent, ventral superficial cells quadrate, papillose, similar to laminal cells, dorsal superficial cells elongate, smooth; in section guide cells 4, large, with several dorsal supplementary cells, ventral cells in 2–3 rows, large, weakly thickened, ventral surface cells smaller, papillose, dorsal stereid band strong, in 4–5 rows, dorsal surface cells undifferentiated, smooth. *Upper laminal cells* quadrate to hexagonal, weakly thickened, papillae 1–4, large, C- or O-shaped; basal cells highly differentiated, fragile, rectangular, vertical walls thin, end walls thickened, reddish; basal marginal cells linear, thickened, forming distinct borders 3–5 cells wide.

Autoicous. Perichaetia terminal, leaves short, spathulate-obovate, apex obtuse. *Seta* 4–6 mm long, red-brown; capsule cylindrical, 2,5–3,0 mm long, yellow-brown, exothecial cells rhomboidal to quadrate, thin-walled; peristome absent; operculum long-rostrate, to 2 mm high; calyptra cylindrical-rostrate, 5,0–5,5 mm long, entire to erose at base; spores with prominent tetrad scar, 34–37 μm, distal surface warty, red-yellow. Fig. 48: 13–22.

Widespread in the Northern Hemisphere, *E. vulgaris* is also known from Australia and Southern Africa. In the Flora area, the species is found on soil in rock crevices in mountainous areas of the south-western and central Cape, Transkei and Lesotho. Map 66.

Vouchers: *Magill* 4227; *Schelpe* 4927; *Van Rooy* 42.



MAP 66.— ● **Encalypta ciliata**
× **Encalypta vulgaris**

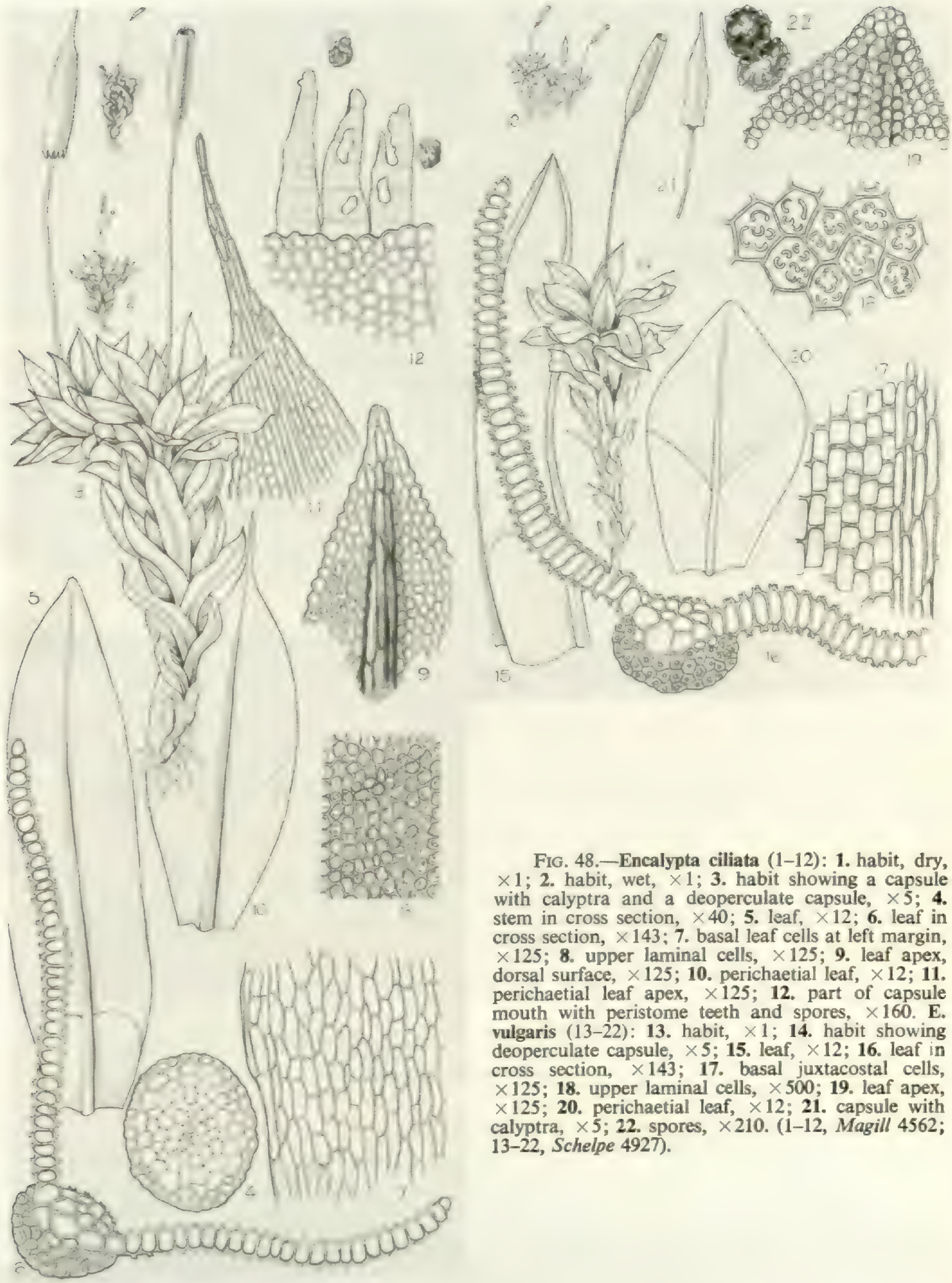


FIG. 48.—**Encalypta ciliata** (1–12): **1.** habit, dry, ×1; **2.** habit, wet, ×1; **3.** habit showing a capsule with calyptra and a deoperculate capsule, ×5; **4.** stem in cross section, ×40; **5.** leaf, ×12; **6.** leaf in cross section, ×143; **7.** basal leaf cells at left margin, ×125; **8.** upper laminal cells, ×125; **9.** leaf apex, dorsal surface, ×125; **10.** perichaetial leaf, ×12; **11.** perichaetial leaf apex, ×125; **12.** part of capsule mouth with peristome teeth and spores, ×160. **E. vulgaris** (13–22): **13.** habit, ×1; **14.** habit showing deoperculate capsule, ×5; **15.** leaf, ×12; **16.** leaf in cross section, ×143; **17.** basal juxtacostal cells, ×125; **18.** upper laminal cells, ×500; **19.** leaf apex, ×125; **20.** perichaetial leaf, ×12; **21.** capsule with calyptra, ×5; **22.** spores, ×210. (1–12, *Magill* 4562; 13–22, *Schelpe* 4927).

The erose to entire base of the calyptra is the most obvious character to separate this species from *E. ciliata*. In addition, the spores of *E. vulgaris* have large wart-like processes on the distal face, while the spores of *E. ciliata* are smooth to papillose distally.

The leaf apices of *E. vulgaris* in Southern Africa are mostly obtuse or occasionally mucronate and slightly cucullate, and the costa is percurrent to subpercurrent. In the Northern Hemisphere, specimens are known with piliferous apices and the costa extending into the hair-point.

POTTIACEAE

Plants small to robust, usually in dense tufts; terricolous, saxicolous or corticolous. *Stems* erect, sympodially branched or rarely monopodially branched; central strand present or absent. *Leaves* appressed or contorted dry, spreading to squarrose wet; linear to oblong or spathulate, or ovate to lanceolate; lamina generally unistratose, rarely bistratose; apex acute to broadly rounded; margins usually entire, occasionally crenulate to dentate above, plane throughout to revolute or involute. *Costa* single, percurrent to excurrent as long or short awn, smooth or denticulate, rarely ending below apex; in section ventral stereid band present or absent. *Upper laminal cells* small, quadrate to hexagonal or rounded, mostly papillose, occasionally mammillose or smooth, generally incrassate; basal cells generally larger, oblong, smooth. *Gemmae* or propagulae occasionally produced on rhizoids, leaves or stem.

Perichaetia terminal or rarely lateral, leaves scarcely differentiated, rarely distinct. *Seta* elongate, rarely shorter than urn; capsule symmetrical, stegocarpic, short- to long-cylindrical or rarely cleistocarpic, globose to oval; peristome present or absent, single, teeth 16, erect to spirally twisted, entire or divided into 32 filaments above membranaceous basal cylinder, papillose to smooth; operculum conical to rostrate; calyptra cucullate; spores mostly round, smooth to strongly papillose.

Pottiaceae is by far the largest family of mosses with 89 genera. The family is also the largest in Southern Africa, with 27 genera found most frequently in woodland, shrubland or grassland communities.

Key to Subfamilies and Tribes

1 Capsules cleistocarpic:
2 Costa in section reniform, ventral stereid band strong..... Subfamily TRICHOSTOMOIDEAE (p. 249)
2 Costa in section round, without ventral stereid band..... Tribe **Pottieae** (p. 192)
1 Capsules stegocarpic:
3 Costa without ventral stereid band, ventral cells occasionally incrassate..... Subfamily POTTIOIDEAE (p. 178)
3 Costa with ventral stereid band strong or weak:
4 Stems without central strand:
5 Leaf margins recurved in base, frequently toothed above; laminal cells with strongly spinose or forked papillae..... Tribe **Leptodontieae** (p. 186)
5 Leaf margins plane, entire; laminal cells with low, blunt papillae:
6 Plants small; peristome absent; leaves 1–2 mm long..... Tribe **Pleuroweisieae** (p. 179)
6 Plants larger; peristome present; leaves 2,5–5,0 mm long:
7 Leaves narrow, linear-lanceolate, lamina flat to weakly convolute..... Subfamily TRICHOSTOMOIDEAE (p. 249)
7 Leaves broad, ligulate, lamina rugose..... Tribe **Barbuleae** (p. 227)
4 Stems with central strand present but occasionally very weak:
8 Leaf margins completely or in part recurved to revolute.... Tribe **Barbuleae** (p. 227)
8 Leaf margins plane or involute:
9 Leaf margins involute..... Subfamily TRICHOSTOMOIDEAE (p. 249)

9 Leaf margins plane:
10 Laminal cells smooth to mammillose:
11 Lamina bistratose juxtacostally.....Subfamily TRICHOSTOMOIDEAE (p. 249)
11 Lamina unistratose.....Tribe **Barbuleae** (p. 227)
10 Laminal cells papillose:
12 Papillae C-shaped or rarely with 1–2 low, sharp, indistinct papillae per cell; leaves ligulate to lanceolate, 1–2 mm long, or lamina broadly oblong, 3–4 mm long, rugose.....Tribe **Barbuleae** (p. 227)
12 Papillae numerous, low and blunt, frequently obscuring cells, not C-shaped; leaves linear to oblong or lanceolate, occasionally elliptical or narrowly spathulate, 2–6 mm long..Subfamily TRICHOSTOMOIDEAE (p. 249)

Subfamily POTTIOIDEAE

Plants minute to large, gregarious or forming dense cushions; terricolous, saxicolous or corticolous. *Stems* erect; central strand present or absent. *Leaves* generally broad, orbicular or oval to lanceolate or ligulate to spathulate; margins plane to revolute. *Costa* infrequently bearing filaments or lamellae on ventral surface, percurrent to very long-excurrent, frequently dentate; in section with or without ventral stereid band. *Upper laminal cells* large or small, papillose or smooth; contact with basal cells straight across leaf *or* laminal cells extending down margins forming distinct ∩-shaped pattern at junction with basal cells. *Gemmae* frequently produced on rhizoids, stems or leaves.

Capsules globose or oval to long-cylindrical; peristome present or absent, teeth generally long-filiform above basal membrane, erect to spirally twisted; operculum conic to rostrate; calyptra cucullate.

Key to Tribes of Pottioideae

1 Ventral stereid band present, occasionally weak or absent in some leaves:
2 Stem with central strand:
3 Peristome absent or rudimentary; leaves narrow; margins plane or recurved on one side..... **Pleuroweisieae** (p. 179)
3 Peristome well developed, if absent, leaves broadly elliptical; margins revolute or occasionally plane..... **Barbuleae** (p. 227)
2 Stems without central strand:
4 Plants large *or* wiry, very loosely caespitose; leaf margins recurved below, frequently toothed above..... **Leptodontieae** (p. 186)
4 Plants small to medium, in dense cushions; leaf margins plane or recurved on one side, infrequently toothed at shoulders.....**Pleuroweisieae** (p. 179)
1 Ventral stereid band absent:
5 Leaves mostly broadest at middle or above, orbicular to elliptical or lingulate to spathulate; leaf cells generally large with several C-shaped papillae, or infrequently smooth or mammillose.....**Pottieae** (p. 192)
5 Leaves ovate to lanceolate, broadest below middle; papillae rarely C-shaped:
6 Leaf cells spinose-papillose; leaves in 3-ranks.....**Leptodontieae** (p. 186)

6 Leaf cells with low, blunt papillae, smooth or mammillose; leaves not 3-ranked:

7 Leaf cells with low, blunt papillae, frequently obscuring cells; leaf margins plane ..... **Pleuroweisieae** (p. 179)

7 Leaf cells mammillose, weakly papillose or smooth; leaf margins recurved to revolute below, plane to revolute above or, if plane throughout, margins bistratose..... **Barbuleae** (p. 227)

Tribe **PLEUROWEISIEAE**

Plants small to medium, in cushions; saxicolous or terricolous. *Stems* with or without central strand. *Leaves* ligulate, lanceolate or triangular; apex obtuse to rounded or broadly acute; margins frequently serrate to denticulate. *Costa* ending well below apex to percurrent; ventral stereid band present or absent, dorsal stereid band strong. *Upper laminal cells* rounded, quadrate to short-rectangular, papillae low, blunt, frequently obscuring cells; basal cells moderately differentiated, rectangular, smooth.

Capsules terminal or on short lateral branches, stegocarpic; peristome absent or rudimentary; operculum rostrate; calyptra cucullate; spores small.

Key to Genera of Tribe Pleuroweisieae

1 Stems monopodial; archegonia borne on short lateral branches; perichaetial leaves strongly differentiated..... 1. **Anoectangium**

1 Stems sympodial; archegonia borne terminally on main stem; perichaetial leaves only weakly differentiated:

2 Plants dark green, dull; leaves narrowly lanceolate; margins frequently denticulate at shoulders, bistratose above.....3. **Gymnostomum**

2 Plants light to yellowish green, if dark green then glossy; leaves ligulate to lanceolate; margins entire, unistratose:

3 Plants often glossy; leaves strongly keeled; margins recurved on one or both sides below; capsules systylious..... 2. **Hymenostylium**

3 Plants dull; leaves plane or weakly keeled; margins plane; operculum deciduous .....3. **Gymnostomum**

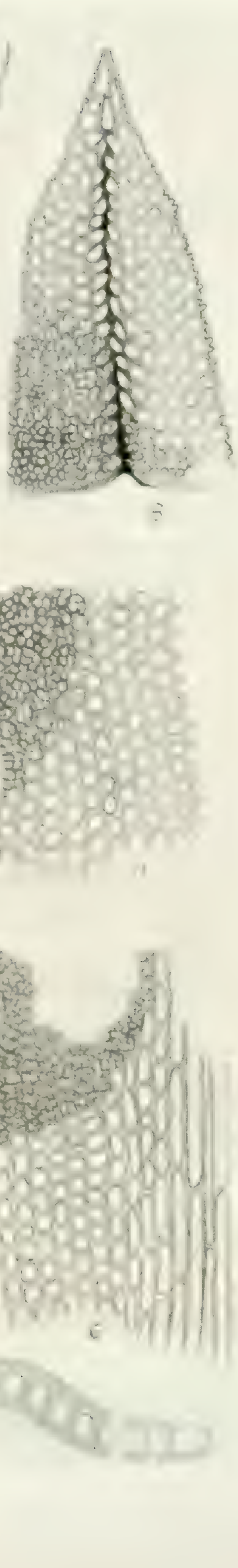
1. ANOECTANGIUM

Anoectangium *Schwaegr.*, Spec. Musc. Suppl. 1: 33 (1811), nom. cons.; Saito in J. Hattori bot. Lab. 39: 455 (1975). Type species: *A. compactum* Schwaegr.

Plants small, forming dense tufts. *Stems* monopodial; central strand present. *Leaves* patent; ligulate to ovate-lanceolate. *Costa* with dorsal stereid band only. *Laminal cells* small, obscure, papillose.

Perichaetial leaves distinct; capsule on short lateral branches, peristome absent; operculum long-rostrate, deciduous.

There are c. 65 species of *Anoectangium*. The genus is found throughout the world, although the majority of species are known from the Tropics. The plants occur most frequently on rock at upper elevations. In Southern Africa, *Anoectangium* occurs throughout the Drakensberg range.



Anoectangium wilmsianum (*C. Müll.*) *Par.*, Ind. Bryol. Suppl. 13 (1900); Sim, Bryo. S. Afr. 267 (1926). Type: Transvaal, Lydenburg, *Wilms* s.n. (G, holo.!).

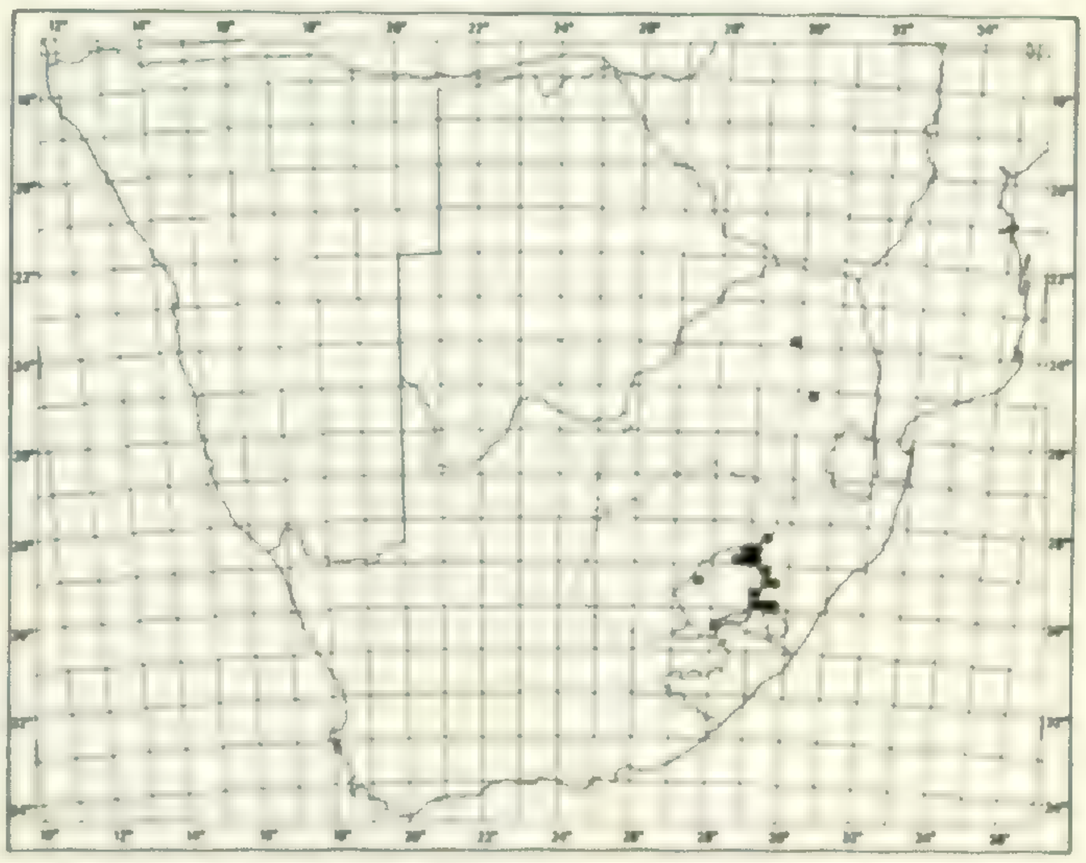
Zygodon wilmsianum C. Müll. in Hedwigia 38: 113 (1899).

Anoectangium assimilis Broth. & Wag. in Trans. R. Soc. S. Afr. 4: 5 (1914). Type: Natal, *Wager* s.n. (PRE!).

Plants slender, frequently very tall, forming dense cushions, green to yellow-green; saxicolous or infrequently terricolous. *Stems* 5–20 mm tall, occasionally irregularly branched below, sparsely tomentose below; in section round to angular, central strand small, rarely blackish, inner cortical cells lax, outer cortical cells in 2 rows, stereids, reddish; axillary hairs of 7–8 cylindrical cells, hyaline throughout. *Leaves* crowded, incurved, twisted dry, patent wet; ligulate to lanceolate, high altitude specimens broader, ovate-lanceolate, 0,8–1,2 mm long; ventral surface deeply and narrowly grooved along costa; apex acute, mucronate by 1–3 smooth, translucent cells; base scarcely differentiated, frequently concave juxtacostally; margins plane, entire. *Costa* strong, percurrent; ventral superficial cells rectangular, smooth or rarely papillose, dorsal superficial cells long-rectangular, papillose; in section semicircular, lamina inserted ventrally, guide cells 2, exposed, ventral cells generally lacking, dorsal stereid band strong, 2–3 cells thick, dorsal surface cells substereids. *Upper laminal cells* rounded, quadrate to short-rectangular or triangular, incrassate, papillae low, blunt, scattered, 3–6 per cell; basal leaf cells quadrate marginally, papillose to near base, juxtacostally quadrate to rectangular, smooth.

Dioicous. Perigonia lateral, gemmate; perichaetia on short lateral branches, leaves very distinct, oval to ovate, abruptly acuminate, 0,7–1,2 mm long, serrate at shoulders; laminal cells rectangular, smooth. *Seta* 4–7 mm long, yellow; capsule oval, 1,0–1,2 mm long, reddish yellow; peristome absent; operculum long-rostrate, 0,8 mm long; calyptra cucullate; spores round, 12–13 μm, spiculate. Fig. 49: 1–10.

Endemic to Southern Africa, *A. wilmsianum* forms dense cushions on rock or soil over rock in the Drakensberg of Lesotho, Natal, Orange Free State and the eastern and northern Transvaal. Map 67.



MAP 67.— ● **Anoectangium wilmsianum**

Vouchers: *Esterhuysen* 26180; *Magill* 5762; *Sim* 9993; *Symons* 8662; *Van Rooy* 22.

The type specimen has the ligulate to lanceolate leaves generally associated with *A. wilmsianum*. Recent collections from high elevation in eastern Lesotho and Giant's Castle, Natal, have ovate-lanceolate leaves, quite distinct from the type. The specimens conform in other characters to *A. wilmsianum*. Variation in leaf shape expressed by all specimens examined, and an intermediate, described by Brotherus and Wager (Wager, 1914) as *A. assimilis*, argue against separation of the high altitude specimens at this time. They may well require infraspecific status after further study.

FIG. 49.—**Anoectangium wilmsianum** (1–10): **1.** habit, ×1; **2.** habit, ×6; **3.** stem in cross section, ×250; **4.** leaves, ×50; **5.** leaf in cross section, ×640; **6.** cells at leaf base (papillae partly shown), ×435; **7.** upper laminal cells at margin (papillae partly shown), ×435; **8.** leaf apex (papillae partly shown), ×435; **9.** perichaetial leaf, ×50; **10.** operculum, ×6. **Hymenostylium recurvirostrum** (11–21): **11.** habit, ×1; **12.** habit, ×3; **13.** stem in cross section, ×250; **14.** leaves, ×35; **15.** leaf in proximal cross section, ×390; **16.** leaf in distal cross section, ×390; **17.** lower left side of lamina (papillae partly shown), ×170; **18.** upper laminal cells, ×640; **19.** calyptra, ×20; **20.** part of capsule mouth, ×435; **21.** systylious capsule, ×10. (1–2 & 9–10, *Symons* 8661; 3–8, *Sim* 9993; 11–21, *Esterhuysen* 26180).

2. HYMENOSTYLIUM

Hymenostylium *Brid.*, Bryol. Univ. 2: 81 (1827); Broth. in Natürl. PflFam. 10: 257 (1924); Gangulee, Moss. E. India 1: 644 (1972). Type species: *H. xanthocarpum* (Hook.) Brid.

Plants in loose cushions, somewhat glossy; saxicolous. *Stems* sympodial, erect, to 20 mm high; lacking central strand. *Leaves* strongly recurved wet, keeled, ligulate; apices acute. *Costa* with dorsal and ventral stereid band. *Laminal cells* quadrate to short-rectangular, papillose.

Perichaetial leaves weakly differentiated; capsule systylious; peristome absent; operculum long-rostrate, persistent.

The genus is known throughout the world, primarily through the wide distribution of *H. recurvirostrum*, although 21 species have been described. Many authors treat these species under *Gymnostomum*. The systylious capsule, with the operculum remaining attached to the columella and elevated above the capsule mouth when dry, argues strongly for the recognition of *Hymenostylium* as a separate genus.

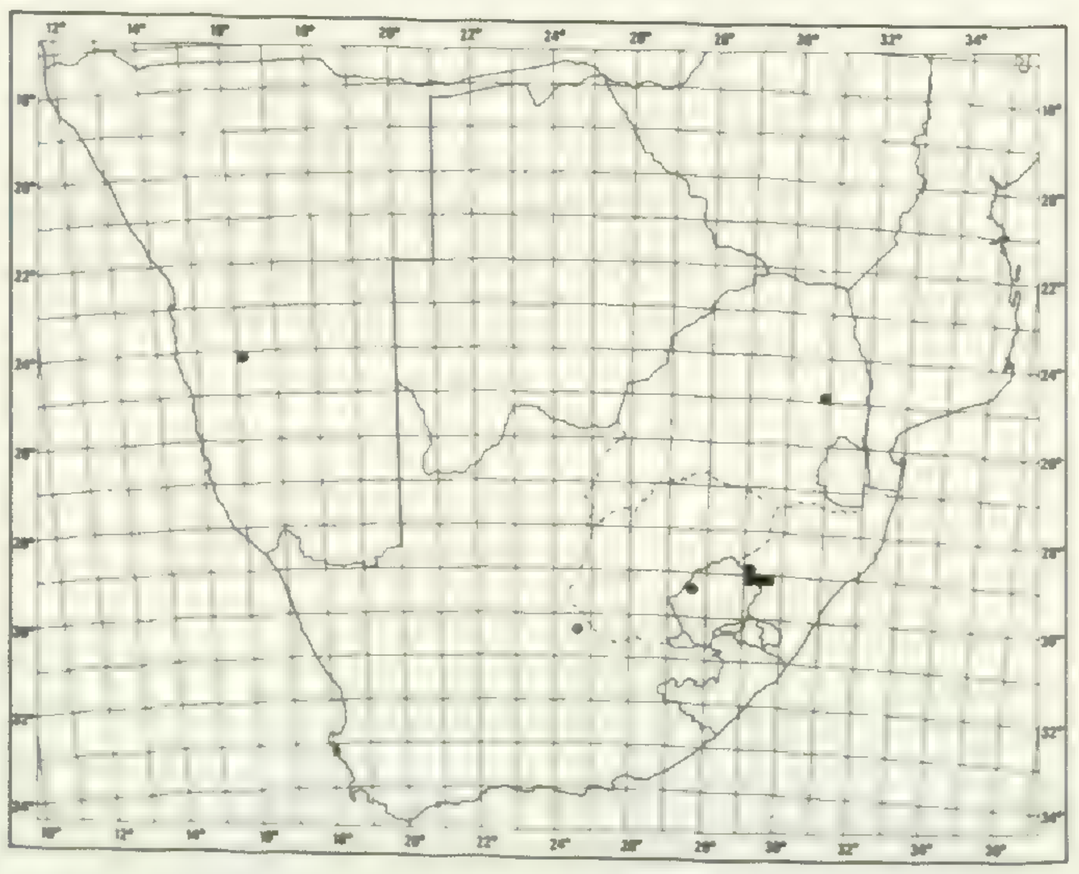
Hymenostylium recurvirostrum (*Hedw.*) *Dix.* in Revue bryol. lichen. 6; 96 (1934); Zander in Bryologist 80: 253 (1977). Type: Europe, *Ehrhart*.

Gymnostomum recurvirostre Hedw., Spec. Musc. 33 (1801); Saito in J. Hattori bot. Lab. 39: 452 (1975).

Plants small, loosely caespitose, yellow-green to dark green, frequently glossy; saxicolous. *Stems* 10–20 mm high, frequently branching by subperichaetial innovations, occasionally papillose, frequently with reddish tomentum below; in section round to angular, central strand absent, inner cortical cells large, thin-walled, outer cortical cells in 1–2 rows, smaller, incrassate, reddish; axillary hairs cylindrical, 6–9 cells long, hyaline throughout. *Leaves* somewhat distant, twisted and appressed dry, recurved to squarrose wet, generally keeled; ligulate to oblong-lanceolate, (0,5–) 1–2 mm long; apex acute; base scarcely differentiated to oval; margins entire, plane to recurved on one or both sides in lower leaf. *Costa* percurrent to just excurrent; ventral superficial cells rectangular, smooth, dorsal cells long-rectangular, papillose, rarely smooth; in section semicircular to oval, guide cells 2, ventral stereid band weak, 1 (–2) layer(s) thick, ventral surface cells rarely present, thin-walled, dorsal stereid band 3–4 layers thick, dorsal surface cells distinct, outer wall strongly thickened, lumen crescent-shaped. *Upper laminal cells* quadrate to short-rectangular, irregularly thickened, especially at corners, papillae scattered, low, blunt, 2–3 per cell; basal cells moderately differentiated, rectangular, smooth, thin-walled.

Dioicous. Perigonia terminal, gemmiform; perichaetia terminal, leaves weakly differentiated, 1,5 mm long. *Seta* 4–8 mm long, reddish brown to yellowish; capsule systylious, urn oval to short-cylindrical, 0,8–1,2 mm long, reddish brown; peristome absent; operculum obliquely rostrate, 0,4–0,8 mm long, cells not twisted; calyptra cucullate, 1,2–1,5 mm long; spores round, 10–12 μm, granulate, brown. Fig. 49: 11–21.

This species is known from North, Central and South America, Europe, Africa, Asia and Australasia. In Southern Africa, specimens of *H. recurvirostrum* are collected on damp or moist rock, generally in



MAP 68.— ● **Hymenostylium recurvirostrum**

association with waterfalls or seepage areas. Most Southern African specimens have come from the Drakensberg of western Natal and Lesotho; however, a few collections have been made in shaded creek beds or rock cliffs in central South West Africa/Namibia, central Cape and eastern Transvaal. Map 68.

Vouchers: *Esterhuysen* 21624; *Magill* 4833; *Phelan & Smook* 73; *Schmitz* 8101.

Hymenostylium recurvirostrum is identified by its glossy appearance, keeled leaves, and lower leaf margins generally recurved on one side. When sporophytes are present, the persistent operculum, even on empty capsules, will separate the species from other taxa in the Flora.

The east African species, *H. crassinervium*, is very similar, but differs in linear to narrowly ligulate leaves, short-excurrent costa and a single low, blunt papilla per lumen. The species is known as far south as Zimbabwe, but has not been recorded from Southern Africa.

3. GYMNOSTOMUM

Gymnostomum *Nees & Hornsch.*, Bryol. Germ. 1: 153 (1823), nom. cons.; Saito in J. Hattori bot. Lab. 39: 450 (1975). Type species: *G. calcareum* Nees & Hornsch.

Plants small to medium, dark green to glaucous-green; terricolous or saxicolous. *Stems* sympodial; central strand present or absent. *Leaves* ligulate to linear-lanceolate, unistratose or bistratose; apex obtuse to acute or frequently rounded; margins entire to denticulate at shoulders. *Costa* percurrent to ending below apex. *Laminal cells* quadrate, papillose.

Perichaetia terminal, leaves only weakly differentiated; peristome absent; operculum rostrate, deciduous.

The 14 species of *Gymnostomum* are widely distributed throughout the world. The variable species *G. aeruginosum* is almost cosmopolitan and generally found in association with calcareous or other basic rock. *Gymnostomum lingulatum* and *G. bewsii* are endemic to Southern Africa.

1 Central strand present; leaves ligulate to linear-lanceolate, 0,4–1,5 mm long.....1. *G. aeruginosum*
1 Central strand absent; leaves 1–2 mm long:
2 Leaves lanceolate to ± triangular, unistratose; margins entire.....2. *G. lingulatum*
2 Leaves linear to linear-lanceolate, bistratose; margins frequently denticulate at shoulders.....3. *G. bewsii*

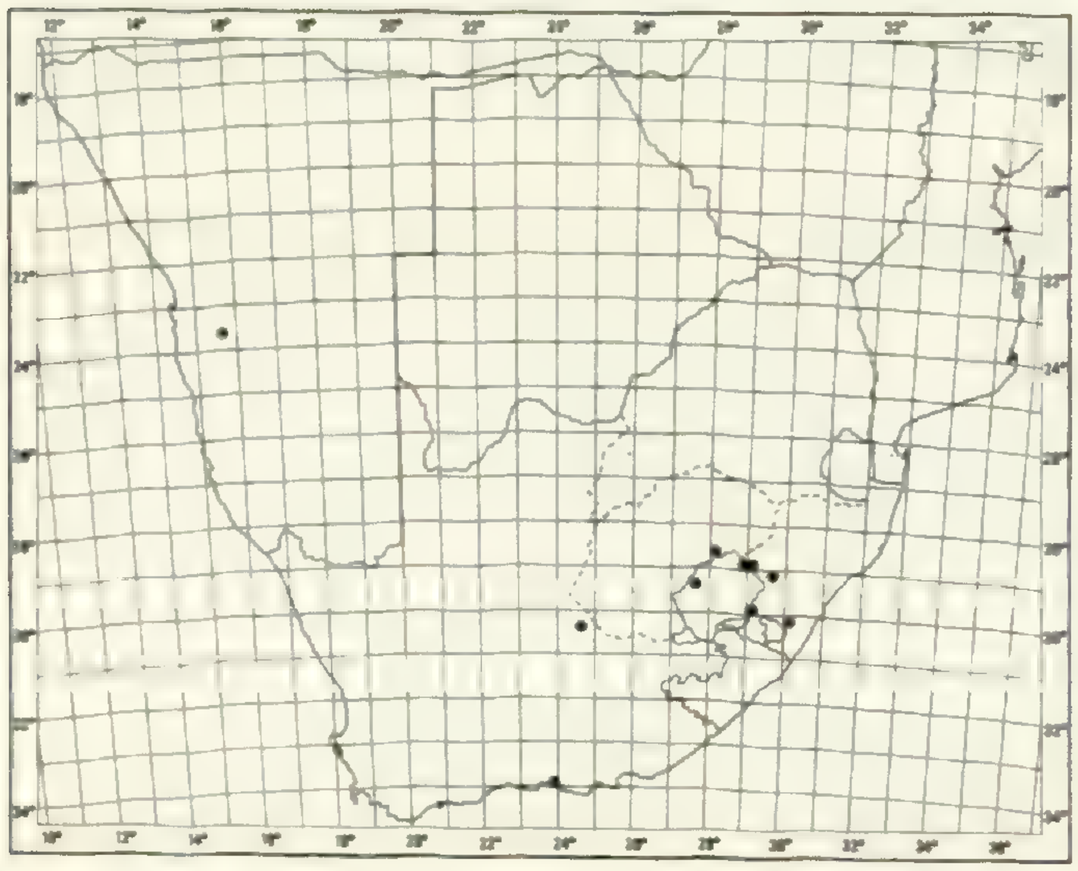
1. **Gymnostomum aeruginosum** *J. E. Sm.*, Fl. Brit. 3: 1163 (1804); Zander in Bryologist 80: 259 (1977). Type: Europe.

Gymnostomum calcareum Nees & Hornsch., Bryol. Germ. 1: 53 (1823). Type: Germany.

Plants small, in loose tufts or cushions, yellow-green to light green, brownish below; terricolous or saxicolous. *Stem* 1,0–2,5 mm tall, simple or sparsely branched below; in section angular, central strand small, inner cortical cells lax, outer cortical cells in 1–2 rows, incrassate, reddish; axillary hairs 3–6 cells long, hyaline throughout. *Leaves* incurved to appressed dry, recurved wet; ligulate to linear-lanceolate, 0,4–1,5 mm long; apex obtuse to rounded or broadly acute and apiculate; base oblong; margin plane, entire. *Costa* ending 2–5 cells below apex to percurrent; ventral superficial cells quadrate to rectangular, sparsely papillose, occasionally densely papillose above, dorsal superficial cells rectangular, papillose; in section semicircular, guide cells 2, ventral stereid band absent or rarely 1–2 cells over guide cells, ventral surface cells similar to guide cells, papillose, dorsal stereid band strong, 4 cells thick, dorsal surface cells rarely differentiated, papillose. *Upper laminal cells* quadrate or a few short-rectangular, weakly thickened, papillae crowded, low, simple, 4–6 per cell; basal cells hyaline, rectangular, thin-walled, smooth.

Dioicous. Perigonia gemmate; perichaetia terminal, leaves weakly differentiated, ovate-lanceolate, sheathing below, 1,5 mm long. *Seta* 4–5 mm long, yellowish; capsule elliptical, 0,5–0,8 (–1) mm long, yellow-red; peristome absent; operculum rostrate, to 0,5 mm long; calyptra cucullate, 1,2 mm long; spores round, 9–12 μm, granulate. Fig. 50: 18–26.

Gymnostomum aeruginosum is known from North, Central and South America, Europe, Africa and Asia. In Southern Africa the species is collected on sandstone or other basic rocks or soils. It is rare in the central and southern Cape and South West Africa/Namibia and infrequent in the Drakensberg of Natal, Lesotho and Orange Free State. Map 69.



MAP 69.— ● **Gymnostomum aeruginosum**

Vouchers: *Cholnoky* 1041; *Gibb* PRE-CH6037; *Magill* 4278; *Schmitz* 8106; *Sim* 9057.

Specimens of *G. aeruginosum* are recognized by their small size, ligulate leaves with obtuse apices and the costa not reaching the apex. The low, simple leaf cell papillae should indicate the relationship to Pleuroweisieae, and the terminal sporophytes and early deciduous operculum will separate specimens from other related genera.

2. **Gymnostomum lingulatum** *Rehm. ex Sim,* Bryo. S. Afr. 260 (1926). Type: Transvaal, Lechlaba, *Rehmann* 437 (PRE, holo.!; BM!; BOL!).

Didymodon lingulatum (Sim) Magill in Mem. bot. Surv. S. Afr. 43: 5 (1979).

Plants medium-sized, loosely caespitose, dark green above, reddish brown below; ?saxicolous. *Stems* 20–30 mm tall, branching, mainly above, sparsely red-tomentose below; in section subquadrate, central strand absent, inner cortical cells lax, outer cortical cells in 1–2 rows, incrassate, reddish; axillary hairs of 6 cylindrical cells, hyaline throughout or basal cell shorter, brownish. *Leaves* somewhat crowded, incurved, weakly twisted dry, patent wet; lanceolate to triangular, 1,0–1,5 mm long; concave ventrally; apex obtuse to acute; base scarcely differentiated; margins plane, entire. *Costa* subpercurrent to ending 4–5 cells below apex; ventral superficial cells rectangular, smooth, dorsal superficial cells rectangular, papillose; in section semicircular, guide cells 4–6, ventral substereid band weak, of 1–2 cells, ventral surface cells incrassate or substereids, dorsal stereid band 1–2 rows thick, dorsal surface cells substereids. *Upper laminal cells* rounded, quadrate or occasionally a few cells short-rectangular or triangular, incrassate, papillae low, simple, 2–4 scattered over cell; basal cells weakly differentiated, rectangular to short-rectangular, hyaline, smooth, thin-walled.

Sporophyte unknown. Fig. 50: 10–17.

Endemic to Southern Africa, *G. lingulatum* is only known from the type locality in the northern Transvaal. Map 70.

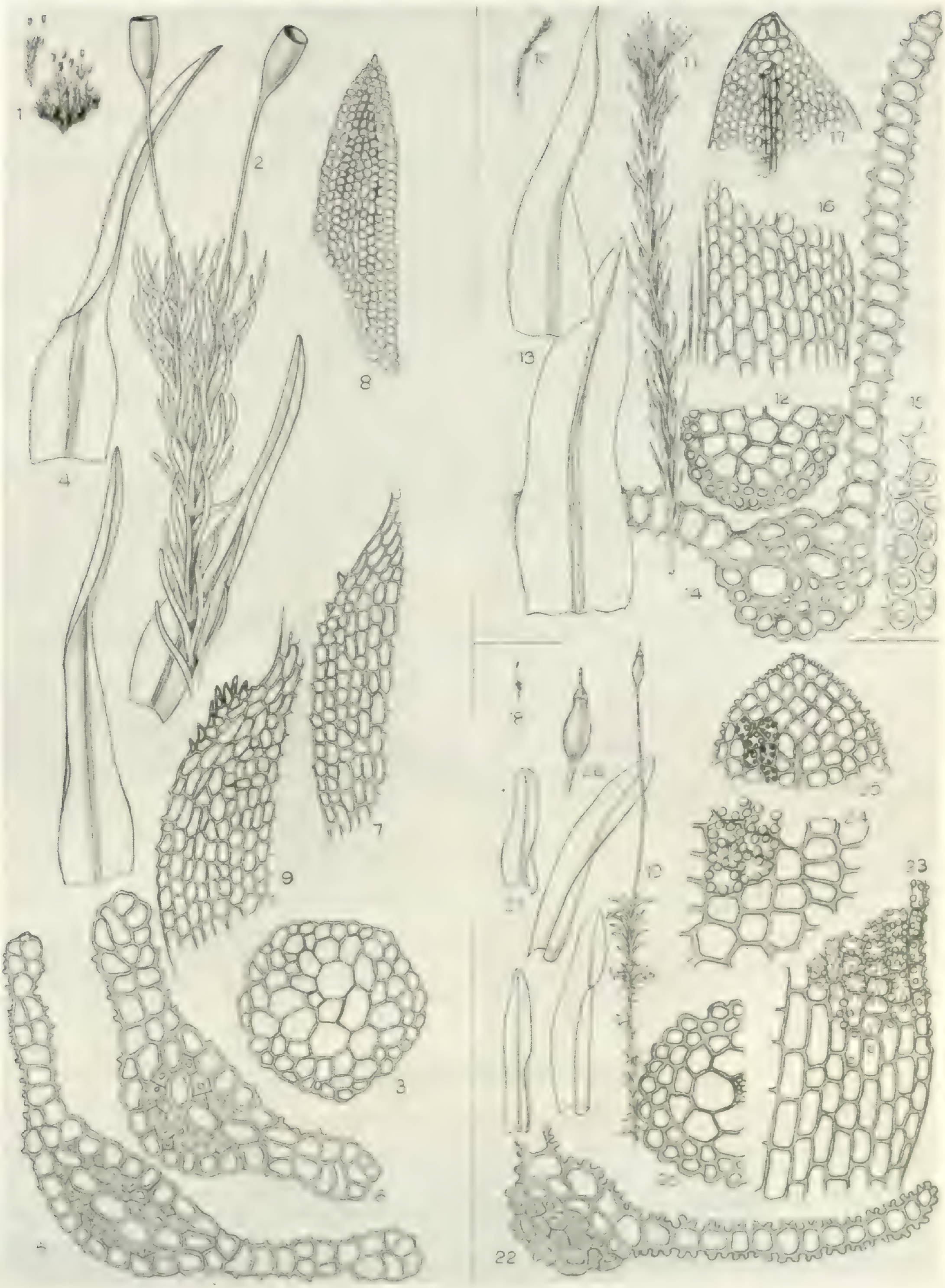
Voucher: Type only.

Re-examination of several plants indicated that the basal cells of axillary hairs may be either hyaline and undifferentiated or brownish and smaller. The variation found by Zander (1977) in axillary hairs of *Gymnostomum,* together with the absence of a central strand in the stem and the low, simple, scattered leaf cell papillae of *G. lingulatum,* indicate that the species may be more correctly placed in *Gymnostomum.*

The plants examined have lanceolate or occasionally triangular leaves. The specific epithet *lingulatum,* used by Rehmann on the specimens of his exsiccate and later adopted by Sim (1926), may indicate a greater variation in leaf shape on other duplicates.

3. **Gymnostomum bewsii** *Dix.* in Trans. R. Soc. S. Afr. 8: 190 (1920); Sim, Bryo. S. Afr. 257 (1926). Type: Transkei, Drakensberg, Ongeluks Nek, *Rowlins* sub *Sim* 8251 (BM, lecto.!, selected here; PRE!).

FIG. 50.—**Gymnostomum bewsii** (1–9): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×225; **4.** leaves, ×40; **5.** leaf in proximal cross section, ×640; **6.** leaf in distal cross section, ×640; **7.** laminal cells at leaf shoulder, ×170; **8.** leaf apex, ×170; **9.** laminal cells at perichaetial leaf shoulder, ×170. **G. lingulatum** (10–17): **10.** habit, ×1; **11.** habit, ×5; **12.** stem in cross section, ×225; **13.** leaves, ×40; **14.** leaf in cross section ×640; **15.** upper laminal cells, ×640; **16.** basal leaf cells, ×170; **17.** leaf apex, ×170. **G. aeruginosum** (18–26): **18.** habit, ×1; **19.** habit, ×10; **20.** stem in cross section, ×320; **21.** leaves, ×40; **22.** leaf in cross section, ×640; **23.** basal leaf cells, ×435; **24.** upper laminal cells (papillae partly shown), ×640; **25.** leaf apex, ×435; **26.** capsule, ×20. (1–2, *Magill* 5745; 3–9, *Wager* 159; 10–17, *Rehmann* 437; 18–26, *Wager* 473).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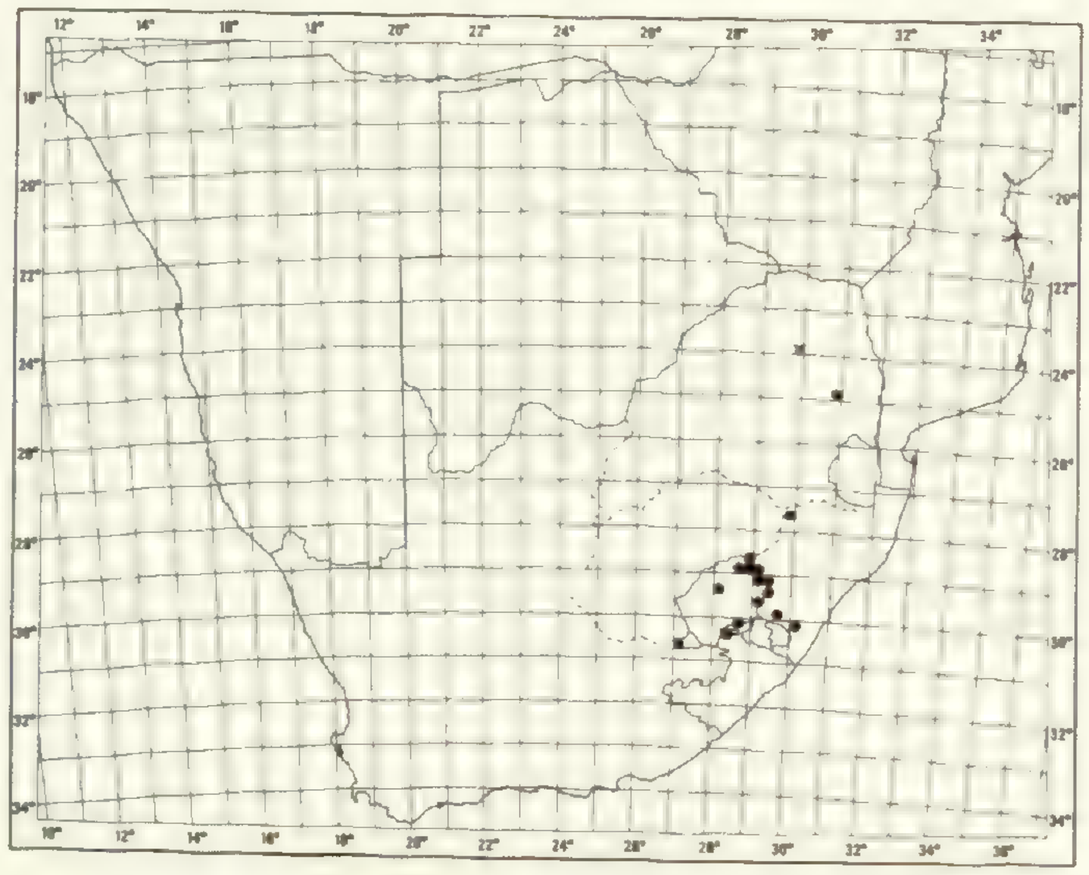
Plants slender, frequently very tall, forming tufts or dense cushions, dark green to light or yellowish green above, light brown below; terricolous or saxicolous. *Stems* erect, 5–20 mm tall, frequently branching; in section round to oval, central strand absent, inner cortical cells lax, outer cortical cells in 1–3 rows, somewhat smaller, incrassate, reddish; axillary hairs 5–10 cells long, hyaline throughout. *Leaves* incurved, slightly twisted dry, widespreading wet; linear to linear-lanceolate, 1–2 mm long; broadly concave ventrally, bistratose above base; apex acute; base scarcely differentiated, oblong to oval, erect-appressed wet; margins plane, entire or infrequently denticulate at shoulders. *Costa* strong, percurrent or just excurrent; ventral superficial cells quadrate to short-rectangular, weakly papillose, dorsal superficial cells rectangular, smooth; in section elliptical to wedge-shaped, guide cells 4–6, large, ventral stereid band 1–2 cells thick, ventral surface cells incrassate, dorsal stereid band 2–3 cells thick, dorsal surface cells with strongly thickened outer walls, lumen semicircular. *Upper laminal cells* quadrate, frequently transversely rectangular at margins, incrassate, papillae low, blunt, simple, 2–4 over lumen; basal cells moderately differentiated, bulging, quadrate to short-rectangular, hyaline, smooth, thin-walled.

Dioicous. Perichaetia terminal, leaves lanceolate to linear, 1,5 mm long, generally dentate to denticulate at shoulders. *Seta* 2,5–3,0 mm long, yellowish; capsule very shortly cylindrical, 1,0–1,2 mm long, reddish yellow; peristome absent; operculum long-rostrate, 0,8 mm long, cells not twisted; spores round, 12–17 μm, papillose, brownish. Fig. 50: 1–9.

Endemic to Southern Africa, *G. bewsii* is infrequently collected in the Drakensberg of Natal, Lesotho, Transkei and Orange Free State, and rarely in the eastern Transvaal. Map 70.

Vouchers: *Esterhuysen* 34595; *Hilliard & Burtt* 10411; *Magill* 4719, 5745.



MAP 70.— ● **Gymnostomum bewsii**
× **Gymnostomum lingulatum**

A few of the specimens cited by Dixon (1920) were misidentified and have been referred to *Anoectangium wilmsianum* (cf. Magill & Schelpe, 1979). The large, fruiting specimen, *Rowlins* sub *Sim* 8251 (BM!), is selected as lectotype, because it most closely matches the protologue. The specimen was cited by Dixon (1920) as 'Coll. Bro. Mayol, comm. Sim (No. 8251)', but original correspondence and specimens at PRE, indicate that the specimen was collected by Mr Rowlins, sent by Bro. Mayol to Sim, who subsequently sent a specimen to Dixon.

The dark green, dense cushions, with linear, bistratose leaves will help to identify collections. The infrequently denticulate margins at the leaf shoulders, especially prominent in perichaetial leaves, were responsible for the erroneous reports of *Eucladium* in Southern Africa. The specimens of *E. verticillatum* cited by Sim (1926) are *G. bewsii*. The accurate illustration of *E. verticillatum* published by Sim (1926) was apparently based on European plants; see comment on his figure.

Tribe LEPTODONTIEAE

Plants medium to large, forming loose tufts or mats; terricolous or saxicolous. *Stems* without central strand, round or triangular, frequently fluted. *Leaves* ovate to ovate-lanceolate; acute to acuminate; margins recurved below, dentate or entire above. *Costa* generally with dorsal and ventral stereid bands. *Laminal cells* rounded, quadrate to hexagonal, incrassate, corners frequently thickened, spinose-papillose or with numerous low papillae over lumen, occasionally forming crown-shaped group.

Sporophyte terminal, perichaetial leaves differentiated. Capsule stegocarpic, cylindrical; peristome present, short, erect; operculum rostrate.

Key to Genera of Tribe Leptodontieae

1 Leaves short, to 2 mm long, ovate to broadly ovate; basal leaf cells not differentiated ..... 1. **Triquetrella**

1 Leaves longer, 2,5–5,0 mm long, ovate-lanceolate; basal leaf cells differentiated.... ..... 2. **Leptodontium**

1. TRIQUETRELLA

Triquetrella *C. Müll.* in Öst. bot. Z. 47: 421 (1897); Broth. in Natürl. PflFam. 10: 264 (1924); Sim, Bryo. S. Afr. 251 (1926). Lectotype species: *T. tristicha* (C. Müll.) C. Müll., vide Grout, Moss Fl. N. Amer. 1: 170 (1938).

Plants wiry, forming loose cushions or mats. *Stems* triangular in section. *Leaves* 3-ranked, ovate, short-acuminate; leaf base decurrent. *Laminal cells* quadrate to rhomboid, spinose-papillose; basal leaf cells not differentiated. Sporophyte not known from Southern Africa, similar to *Leptodontium.*

Of the 11 species of *Triquetrella,* only three are known from the Northern Hemisphere. The other species are found in Australia, New Zealand, South America, Southern Africa, and the Subantarctic Islands. Several of these species appear to be very closely related and the present separation of many of the species is very tentative.

Triquetrella tristicha (*C. Müll.*) *C. Müll.* in Öst. bot. Z. 47: 422 (1897); Broth. in Natürl. PflFam. 10: 265 (1924); Sim, Bryo. S. Afr. 251 (1926). Type: Cape, Swartkop River, *Ecklon* s.n. (BM!).

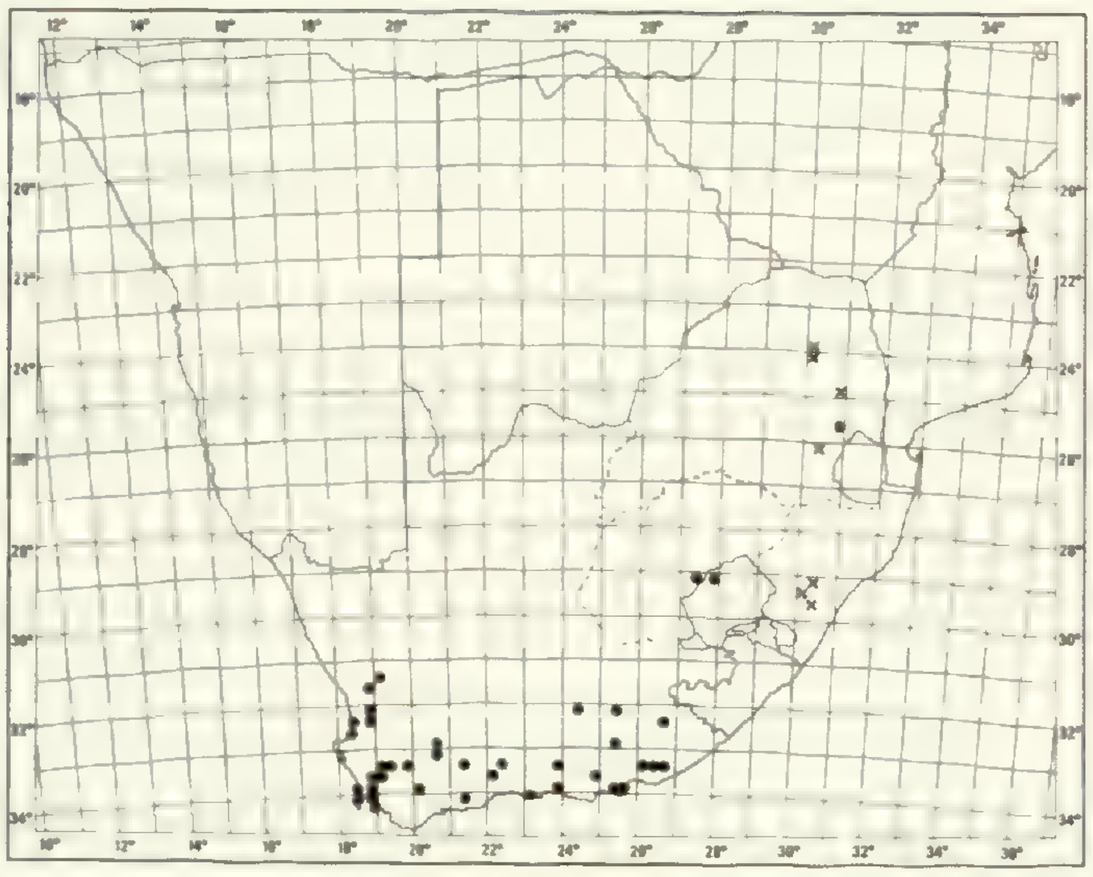
Zygodon tristichus C. Müll. in Bot. Ztg 13: 764 (1855).

Triquetrella strictissima Rehm. ex C. Müll. in Öst. bot. Z. 47: 422 (1897). Type: Cape, Wellington, *Rehmann* 144 (BM!; PRE!).

Plants medium-sized, slender, in loose cushions or mats, yellow-green to dark green, brownish below; terricolous or saxicolous. *Stems* erect or inclined, to 25 mm long, rarely branched; in section triangular, central strand absent, inner cortical cells large, incrassate, yellowish, outer cortical cells in 1–2 rows, stereids, reddish yellow; axillary hairs 6–8 cells long, cylindrical, 1–2 basal cells very short, hyaline throughout. *Leaves* distant below, crowded above, 3-ranked, appressed, twisted dry, patent wet; ovate to broadly ovate or oval, 1,2–2,0 mm long; apex acuminate; base decurrent; margins recurved to mid-leaf, entire. *Costa* percurrent to subpercurrent; ventral superficial cells rectangular, smooth, dorsal superficial cells rectangular to quadrate above, papillose; in distal section round to subround, frequently undifferentiated, especially in upper leaf, cells irregularly placed, incrassate; in proximal section guide cells 2, large, incrassate, ventral stereid band of 1–2 cells, surface cells undifferentiated, dorsal stereid band weak, 1–2 rows thick, dorsal surface cells substereids, outer wall strongly incrassate. *Upper laminal cells* quadrate to short-rhombic, incrassate, in regular rows, papillae strong, spinose or bifid, mostly 1 per cell; basal cells undifferentiated or with small group of rectangular, smooth cells at insertion near costa.

?Dioicous. Perigonia gemmate, leaves sheathing, oval-acuminate, laminal cells rhomboid, smooth. Other parts not seen. Fig. 51: 1–8.

Triquetrella tristicha is common in the southern Cape Province and has also been collected in the eastern Orange Free State and western Lesotho. Most specimens are collected in semi-arid regions; only a few collections have been made in mesic environments. A specimen from Kaapsche Hoop, Transvaal (*Wager* 644, PRE) appears oddly displaced; other Transvaal collections have not been seen. Map 71.



MAP 71.— ● **Triquetrella tristicha**
× **Leptodontium viticulosoides**

Vouchers: *Barnard* 49298; *Esterhuysen* 16598; *Jacot Guillarmod* 6324; *Magill* 6341; *Magill & Schelpe* 3941; *Wager* PRE-CH7675.

Specimens of *T. tristicha* have not been collected in Southern Africa with sporophytes, although a recent collection (*Bayliss* 8522) contained plants with fully developed antheridia. A very closely related Australian species, *T. papillata* (Hook. f. & Wils.) Broth., is said to have 'narrowly cylindrical capsules on a long flexuous seta' and was illustrated (Scott & Stone, 1976) with long-sheathing perichaetial leaves.

FIG. 51.—**Triquetrella tristicha: 1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×150; **4.** leaves, ×40; **5.** leaf in cross section, ×340; **6.** cells at leaf base (right side), ×170; **7.** upper laminal cells, ×640; **8.** leaf apex, ×170. (1–8, *Magill* 3866).

2. LEPTODONTIUM

Leptodontium (*C. Müll.*) *Hampe ex Lindb.* in Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 21: 227 (1864); Zander in Bryologist 75: 230 (1972). Type species: *L. squarrosum* (Hook.) Hampe ex Lindb.

Plants large, forming loose tufts, erect. *Stems* round, fluted or smooth in section. *Leaves* many-ranked, ovate-lanceolate; base not decurrent. *Laminal cells* rounded, quadrate to hexagonal, corners generally thickened, papillae scattered over lumen, numerous, or forming massive crown-shaped group; basal cells rectangular, smooth, thin-walled. *Gemmae* on stem obovoid, multicellular.

Sporophyte terminal; seta elongate; capsule cylindrical; peristome erect, teeth linear, short; operculum rostrate; calyptra cucullate, large; spores papillose.

The genus *Leptodontium* presently comprises about 80 species that are widely distributed in tropical and subtropical regions. In Southern Africa the genus is found along the Drakensberg escarpment of Transvaal, Natal and Lesotho.

1 Stem smooth, not fluted in section.....1. *L. viticulosoides*
1 Stem fluted in section:
  2 Leaves 3–5 mm long; leaf cells incrassate, corners strongly thickened, in section cells bulging with massive crown-shaped papillae.....2. *L. longicaule*
  2 Leaves 2,0–2,5 mm long; leaf cells ± thin-walled, corners not thickened, in section cells ± flat, papillae numerous, scattered over lumen.....3. *L. brachyphyllum*

1. **Leptodontium viticulosoides** (*P. Beauv.*) *Wijk & Marg.* in Taxon 9: 51 (1960); Zander in Bryologist 75: 243 (1972). Type: Réunion, *Bory de St Vincent* s.n.

Neckera viticulosoides P. Beauv., Prodr. 78 (1805). *Didymodon squarrosus* Hook., Musci Exot. 2: 150 (1819). *Trichostomum squarrosum* (Hook.) Schwaegr., Spec. Musc. Suppl. 2: 78 (1823). *Leptodontium squarrosum* (Hook.) Hampe ex Lindb. in Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 21: 227 (1864); Sim, Bryo. S. Afr. 249 (1926). Type: Nepal, *Gardner* s.n. (BM, holo.!).

Zygodon simii Dix. in Trans. R. Soc. S. Afr. 8: 198 (1920). Type: Natal, Swartkop, *Sim* 8690 (BM, holo.!; PRE!).

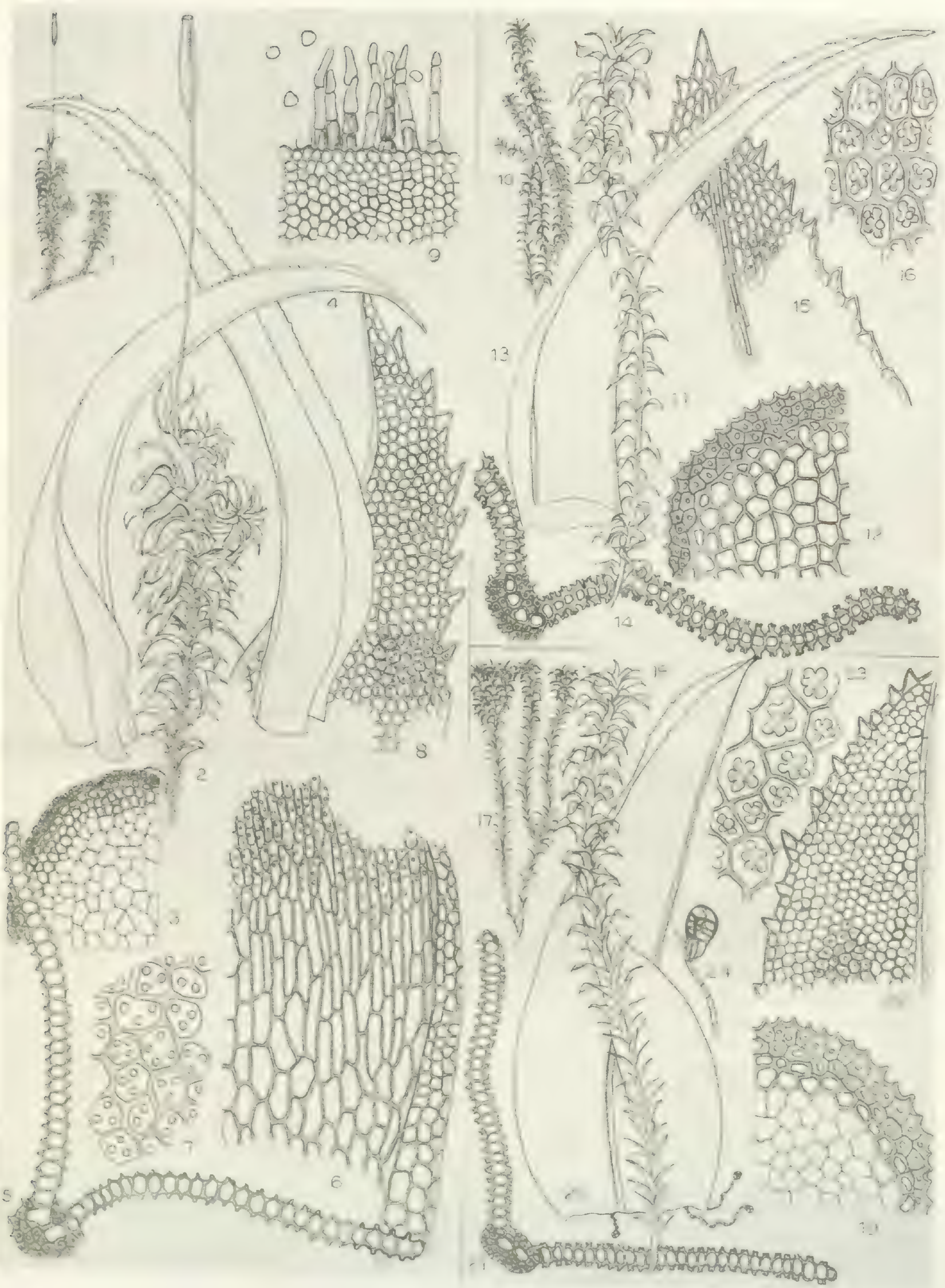
Plants large, in loose tufts, green to yellow-green, brown below; terricolous, saxicolous or corticolous. *Stems* 20–80 mm tall, frequently covered with white tomentum, reddish below; in section round, not fluted, central strand absent, inner cortex large, cells thin-walled, outer 1–2 rows stereids, reddish; axillary hairs 15–16 cells long, filamentous, hyaline throughout. *Leaves* crowded, erect-spreading, twisted or contorted dry, squarrose to recurved wet, weakly keeled; ovate-lanceolate to broadly lanceolate, 3,0–3,5 mm long; apex acuminate, occasionally acute; base ovate, sheathing; margins narrowly recurved below, plane above, dentate in upper leaf. *Costa* subpercurrent; ventral superficial cells rectangular, smooth, dorsal superficial cells rectangular, weakly papillose; in section reniform, guide cells 2–4, large, ventral stereid band 1 (–2) layers thick, exposed, dorsal stereid band 2–3 layers thick, surface cells not differentiated. *Upper laminal cells* rounded-quadrate, corners strongly thickened, with 2–4 small, simple papillae scattered over the cell; basal cells moderately differentiated, long-rectangular, slightly thickened, porose.

Autoicous. Perigonia lateral; perichaetia terminal; leaves long-sheathing, 9–10 mm long. *Seta* 12–15 mm long, yellowish; capsule cylindrical, 4 mm long, red-yellow; peristome short, 0,1 mm long, teeth linear, erect, irregular, properistome present; operculum rostrate, 1,5 mm long; calyptra 6 mm long; spores round, 22–25 μm, weakly papillose. Fig. 52: 1–9.

Specimens are frequently collected, from a large variety of substrates, in the forests of the northern and eastern Transvaal and Natal. Map 71.

Vouchers: *Magill* 3404; *Sim* 8705; *Smook* 848; *Von Breitenbach* 139; *Wager* 121.

The large plants with squarrose-recurved, dentate leaves and white tomentum will help to identify *L. viticulosoides*. The species can be separated from the other two by its non-fluted stems and low, simple leaf papillae.



2. **Leptodontium longicaule** *Mitt.* in J. Linn. Soc., Bot. 12: 51 (1869); Zander in Bryologist 75: 266 (1972). Type: Ecuador, Pichincha, *Spruce* 306 (NY, holo.; BM!).

Plants medium to large, forming large tufts, green to yellow-green, brownish below; terricolous or saxicolous. *Stems* 10–80 mm tall, rarely branched, without tomentum; in section oval, fluted, central strand absent, cells of cortex large, incrassate, strongly thickened toward margin, outer 1–3 rows stereids, reddish; axillary hairs of 14–17 short cells, basal cell brownish. *Leaves* crowded, twisted to contorted above with appressed bases dry, strongly squarrose-recurved wet; ovate-lanceolate, 3–5 mm long; apex acute; base oblong, sheathing; margins narrowly recurved below, serrate in upper leaf. *Costa* subpercurrent; ventral superficial cells long-rectangular, smooth, dorsal superficial cells long-rectangular, finely papillose; in section reniform, guide cells 2–4, large, ventral stereid band 1–2 cells thick, exposed, dorsal stereid band 2–3 cells thick, dorsal surface cells not differentiated. *Upper laminal cells* rounded-quadrate, thickened at corners, bulging superficially, papillae crown-like, massive, centered over lumen; basal cells moderately differentiated, rectangular, thickened, pitted, seriate papillose to lower base.

Sporophyte not known in Southern Africa. Fig. 52: 10–16.

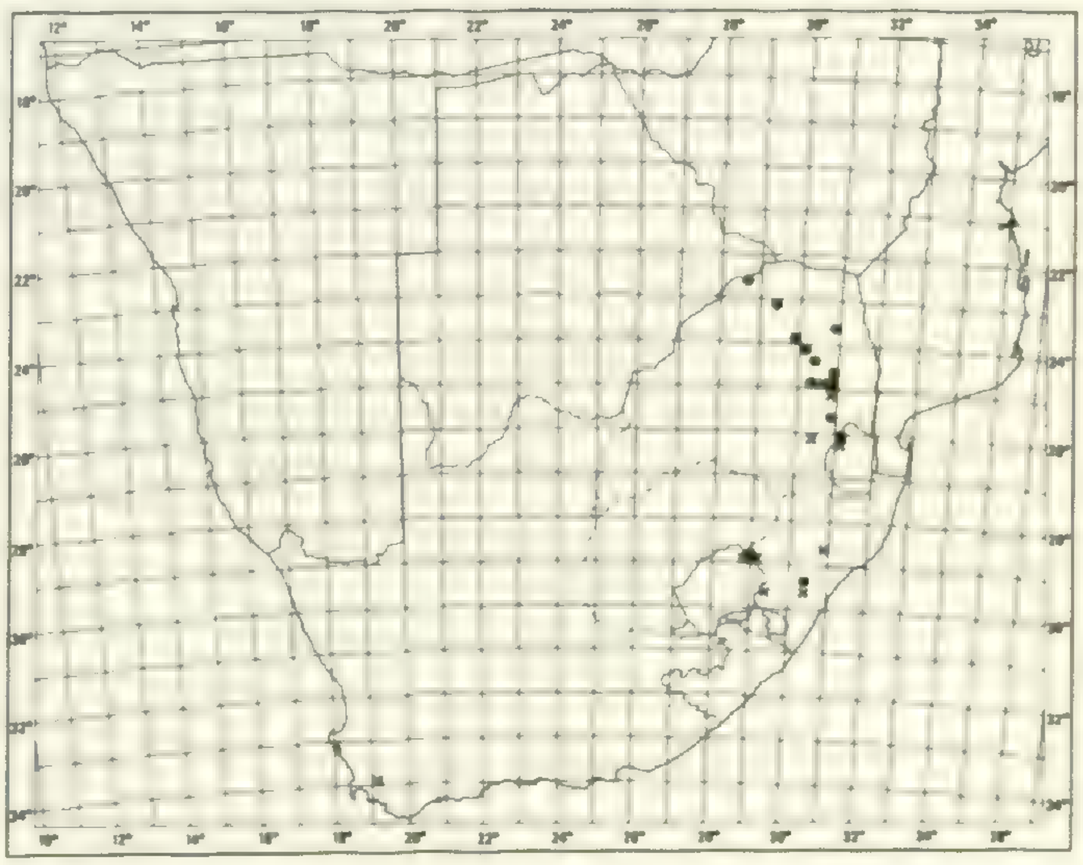
Leptodontium longicaule is known from Central and northern South America, eastern and Southern Africa and several African and American islands. In Southern Africa specimens are frequently collected in forests in northern and eastern Transvaal, Swaziland and Natal. Map 72.

Vouchers: *Crosby & Crosby* 9140; *Magill* 3535, 3753, 4892; *Vorster* 449a.

This species is recognized by its stems appearing fluted when viewed in cross section, strongly squarrose-recurved leaves with serrate margins and the large crown-shaped papillae of the laminal cells. Smaller specimens could be confused with *L. brachyphyllum*, especially collections from areas where their ranges overlap; see note under that species. Both sporophytes and gemmae have been described for *L. longicaule* but neither have been found on Southern African specimens. Zander (1972) in his revision of *Leptodontium*, assigned a specimen (*Wager* 1932, US) to *L. longicaule* var. *microruncinatum* (Dus.) Zander. The variety differs in 'long-lanceolate leaves, to 6 mm, dentate in the upper ½; the upper laminal cells with thickened walls, papillae often obscure or fused into an irregular lens-shaped cap over each lumen. . .'; additional specimens have not been seen.

3. **Leptodontium brachyphyllum** *Broth. & Thér.* in Bull. Acad. int. Géogr. bot. 16: 40 (1906); Zander in Bryologist 75: 272 (1972). Type: Colombia, Bogotá, *Apollinaire-Marie* s.n., 1904 (FH; H; NY).

Plants medium to large, in loose tufts, green to dark green, brown to blackish below; saxicolous. *Stems* 20–80 mm tall, unbranched, sparsely tomentose; in section round, central strand absent, cortical cells large, thickened, outer cortical cells in 1–3 rows, substereids, reddish; axillary hairs filamentous, 15–16 cells long, hyaline throughout. *Leaves* crowded, erect to appressed with weakly twisted tips dry, recurved wet, not strongly keeled; ovate-lanceolate, 2,0–2,5 mm long; apex



MAP 72.— ● **Leptodontium longicaule**
× **Leptodontium brachyphyllum**

FIG. 52.—**Leptodontium viticulosoides** (1–9): **1.** habit, ×1; **2.** habit, ×3; **3.** stem in cross section, ×170; **4.** leaves, ×20; **5.** leaf in cross section, ×200; **6.** cells at leaf base (dorsal right side), ×170; **7.** upper laminal cells, ×640; **8.** leaf apex (dorsal right side, papillae partly shown), ×170; **9.** part of capsule mouth with peristome teeth and spores, ×140. **L. longicaule** (10–16): **10.** habit, ×1; **11.** habit, ×2; **12.** stem in cross section, ×170; **13.** leaf, ×40; **14.** leaf in cross section, ×200; **15.** leaf apex, ×170; **16.** upper laminal cells, ×640. **L. brachyphyllum** (17–24): **17.** habit, ×1; **18.** habit, ×2; **19.** stem in cross section, ×170; **20.** leaf, ×40; **21.** leaf in cross section, ×200; **22.** upper lamina and margin (left side), ×170; **23.** upper laminal cells, ×640; **24.** gemmae, ×170. (1–2, *Smook* 848; 3–9, *Sim* 9667; 10–16, *Magill* 4871; 17–24, *Magill* 4521).

acute; base sheathing; margins recurved to mid-leaf, serrate above. *Costa* subpercurrent; ventral superficial cells rectangular, smooth, dorsal superficial cells rectangular, smooth; in section reniform, guide cells 2–4, large, ventral stereid band 1–3 cells thick, exposed, dorsal stereid band 2–4 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* quadrate to hexagonal or rounded, moderately thickened, not strongly so in corners, papillae numerous, appearing scattered over lumen, low, in section forming a short crown-shaped group over each cell; basal cells moderately defined, short-rectangular, thin-walled, papillae in upper base, weak, scattered. *Gemmae* on stem, obovoid, to 50 μm long, multicellular, brownish.

Sporophytes not known. Fig. 52: 17–24.

Leptodontium brachyphyllum occurs in Central and western South America and Southern Africa. Recent collections have been identified from the southwestern Cape, eastern Lesotho, Natal, Swaziland and eastern Transvaal. Map 72.

Vouchers: *Crosby & Crosby* 7770; *Killick* 4214; *Magill* 4521, 5788; *Vorster* 1745.

There remains some doubt about the identity of these specimens because of a resemblance to *L. longicaule*. The short leaves, sparsely tomentose stems, the slightly bulging, thin-walled, weakly papillose laminal cells and distinct basal cells, however, clearly separate specimens of *L. brachyphyllum*.

Tribe **POTTIEAE**

Plants very small to large, gregarious to loosely caespitose; terricolous, saxicolous or occasionally corticolous. *Stems* erect; central strand present or absent. *Leaves* broad, orbicular to elliptical or lingulate to spathulate; margins plane to revolute, rarely erect, generally entire. *Costa* subpercurrent to frequently long-excurrent; in section without ventral stereid band, occasionally with ventral outgrowths, dorsal stereid band generally strong. *Laminal cells* large, smooth, mammillose or papillose, papillae mostly C-shaped.

Capsule cleistocarpic or stegocarpic; peristome present, rudimentary or absent, teeth mostly long-filamentous, twisted, frequently from high basal membrane; operculum conic, rostrate or obliquely rostrate.

Key to Genera of Tribe Pottieae

1 Ventral costal surface bearing filaments or lamellae:
  2 Costa bearing filaments:
    3 Leaf margins broadly involute; costa in section flattened, undifferentiated..... 1. **Aloina**
    3 Leaf margins erect or revolute; costa in section round, with guide cells and stereid band..... 2. **Crossidium**
  2 Costa bearing lamellae:
    4 Leaves lingulate to broadly lingulate; capsule stegocarpic..... 3. **Pterygoneurum**
    4 Leaves oval to obovate; capsule cleistocarpic..... 4. **Acaulon**
1 Ventral costal surface without filaments or lamellae:
  5 Plants small to minute, ephemeral; capsules cleistocarpic:
    6 Plants bulbiform; capsules immersed..... 4. **Acaulon**
    6 Plants mostly taller; capsules emergent or exserted:
      7 Capsule just emergent..... 5. **Phascum**
      7 Capsule long-exserted..... 6. **Pottia**

5 Plants small to large; capsule stegocarpic:
8 Costa excurrent:
9 Plants very small, bulbiform; leaf margins plane..... 6. **Pottia**
9 Plants large, stems generally elongate; leaf margins revolute..... 8. **Tortula**
8 Costa mucronate, percurrent or ending below apex:
10 Ventral costa strongly convex; in section ventral surface cells enlarged.... 7. **Desmatodon**
10 Ventral costa not strongly convex:
11 Leaf margins crenulate to serrulate..... 5. **Phascum**
11 Leaf margins entire or papillose:
12 Laminal cells mammillose ventrally, flat and smooth to weakly papillose dorsally; leaf margins plane to involute; plants generally glossy; leaves involute dry..... 10. **Weisiopsis**
12 Laminal cells papillose dorsally and ventrally or rarely smooth; leaf margins plane or revolute at least below:
13 Plants large; leaves lingulate to spathulate, 2–3 mm long..... 8. **Tortula**
13 Plants small; leaves oval, ovate, oblong or lingulate, less than 2 mm long:
14 Costa ending below apex..... 9. **Husnotiella**
14 Costa percurrent to excurrent..... 6. **Pottia**

1. ALOINA

Aloina (*C. Müll.*) *Kindb.* in Bih. K. Svenska Vetensk. Akad. Handl. 6: 22 (1882), nom. cons.; Delgadillo in Bryologist 78: 250 (1975); Broth. in Natürl. PflFam. 10: 294 (1924); Sim, Bryo. S. Afr. 233 (1926). Type species: *A. aloides* (Schultz) Kindb.

Plants small, gregarious, olive-green; terricolous. *Stems* very short; central strand absent. *Leaves* lingulate, piliferous; margins broadly involute; ventral leaf surface covered with numerous chlorophyllous filaments. *Costa* excurrent as a long, smooth, hyaline awn; in section flattened, undifferentiated. *Laminal cells* transversely rectangular, smooth.

Dioicous. *Capsules* long-exserted, cylindrical; peristome teeth linear, papillose, twisted above short basal membrane; operculum conical; calyptra cucullate, smooth; spores small, round.

The 9 species of *Aloina* are mostly restricted to the Northern Hemisphere, although 2 species are South American endemics. The Southern African species is widely distributed and presently also known from the United States, Mexico, the Mediterranean Region, Australia and New Zealand.

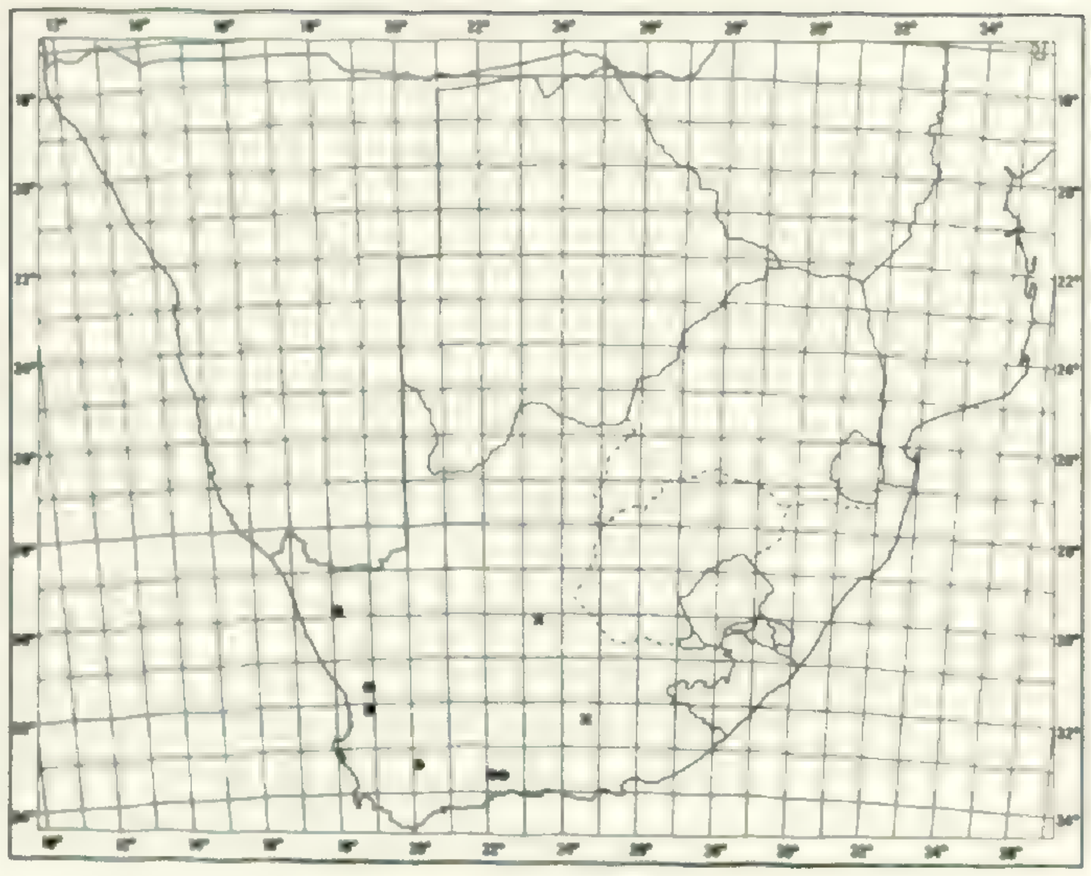
Aloina bifrons (*De Not.*) *Delgadillo* in Bryologist 78: 251 (1975). Type: Italy.

Tortula bifrons De Not. in Mem. R. Sci. Torino 40: 305 (1838).

Barbula dregeana C. Müll in Gen. Musc. Fr. 432 (1900). Type: Cape, Namaqualand, Zilverfontein, *Drège* s.n., 1830.

Aloina rigida sensu Sim, Bryol. S. Afr. 233 (1926), non (Hedw.) Limpr. (1888).

Plants small to very small, gregarious, dark green to olive-green; terricolous. *Stems* short, to 3 mm high, simple; in section without central strand, cortical cells thin-walled, gradually smaller toward margins. *Leaves* incurved dry, widespreading wet; lingulate to ovate-lingulate, 0,8–2,0 mm long, frequently constricted above base; apex piliferous; base sheathing; margins entire to serrulate, broadly involute above base. *Costa* long-excurrent, to 1 mm long, fragile, hyaline, smooth; ventral surface bearing numerous cylindrical filaments, dorsal superficial cells rounded, quadrate to rectangular; in section flattened, undifferentiated, 2–4 cells thick, ventral cells



MAP 73.— ● **Aloina bifrons**
× **Pterygoneurum macleanum**

thin-walled, ventral filaments 4–8 cells high, lower filament cells round, becoming cylindrical above, terminal cells elliptical-acute, strongly thickened apically, dorsal surface cells strongly thickened. *Upper laminal cells* transversely elongate, incrassate, strongly incrassate dorsally, smooth; basal cells quadrate to rectangular.

Dioicous. Perichaetia terminal, leaves clasping, variable in shape. *Seta* 7–8 mm long, yellowish red; capsule cylindrical to ovoid-cylindrical, 1,5–2,5 mm long, dark red; peristome spirally twisted, teeth linear above short basal membrane, yellowish, finely papillose; operculum conical, erect, to 1 mm long; spores round, 10–12 μm, finely papillose to almost smooth. Fig. 53: 1–9.

The widely distributed species, *A. bifrons*, is restricted in Southern Africa, to arid and semi-arid shrublands of the western and southern Cape Province. Map 73.

Vouchers: *Lavranos* 15206*a*; *Magill* 6075; *Magill & Schelpe* 3878a, 3918.

The lingulate leaves with long-excurrent costa, broadly involute leaf margins and numerous ventral, photosynthetic filaments characterize this species.

FIG. 53.—**Aloina bifrons: 1. habit,** ×1; **2. habit,** ×5; **3.** leaves, ×40; **4.** leaf in distal cross section, ×170; **5.** cells at leaf base (left side), ×80; **6.** marginal cells and filaments (ventral view), ×80; **7.** leaf apex, ×80; **8.** capsule and detached operculum, ×10; **9.** part of capsule mouth with peristome teeth, ×170. (1–9, *Magill & Schelpe* 3896).

2. CROSSIDIUM

Crossidium *Jur.*, Laubmfl. Oest. Ungarn 127 (1882), nom. cons.; Delgadillo in Bryologist 78: 269 (1975). Type species: *C. squamiferum* (Viv.) Jur.

Plants small to minute, scattered or loosely caespitose; terricolous. *Stems* simple; central strand weak. *Leaves* suborbicular to oblong-lanceolate; apex apiculate, subcucullate; margins erect or revolute, entire or notched. *Costa* percurrent to mucronate; ventral surface bearing numerous filaments, dorsal stereid band strong. *Upper laminal cells* quadrate, weakly thickened.

Sporophyte terminal; capsule cylindrical, reddish; peristome teeth filamentous above exserted basal membrane; operculum conic to rostrate; calyptra cucullate; spores round, weakly papillose to smooth.

The genus *Crossidium* consists of 8 species found primarily in arid or semi-arid regions of both hemi spheres. In Southern Africa, the genus is found in the northern and western Cape and South West Africa Namibia. Specimens are rarely collected on crusts of soil under shrubs or in association with rock outcrops.

1 Plants bulbiform; leaves appressed wet or dry; apical cell of costal filaments conical, smooth ..... 1. *C. apiculatum*

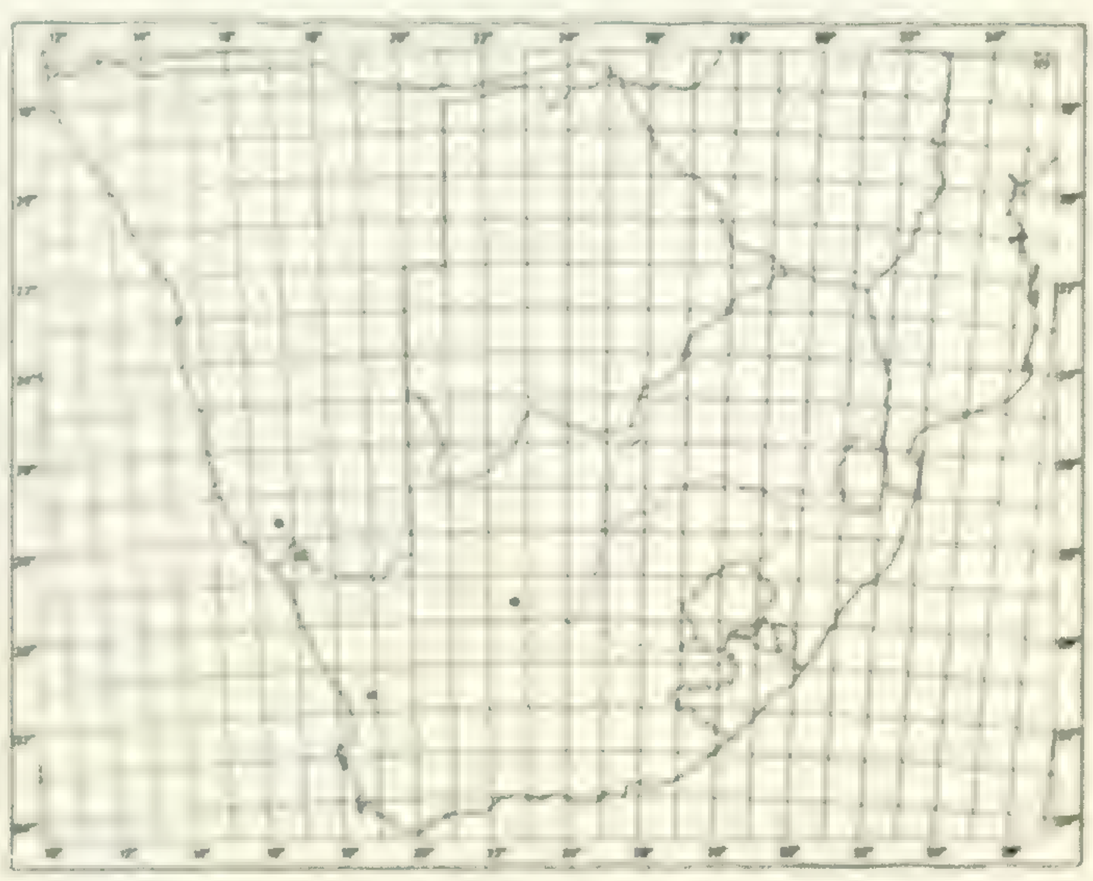
1 Plants larger; leaves spirally twisted around stem dry, erect-spreading wet; apical cell of costal filaments subglobose, papillose ..... 2. *C. spiralifolium*

1. **Crossidium apiculatum** *Magill*, sp. nov., *speciebus omnibus* Crossidii *Jur. foliis suborbicularibus ad ovalibus, apicibus apiculatis, cellulis laminae laevibus minute crassatis, cellulis apicalibus filamentorum costae laevibus conicis differt.*

Type: Cape, Knersvlakte, near Kobee, 6 km NE of Vanrhynsdorp, along road to Niewoudtville, *Magill & Schelpe* 3877 (PRE, holo.; BOL; H; MEXU; MO; NY).

Plants minute, bulbiform, scattered, yellow-green; terricolous. *Stems* to 1 mm tall, unbranched; in section round, central strand very small, weak, cortical cells lax. *Leaves* crowded, appressed dry or wet, concave; suborbicular to oval, 0,6–0,8 mm long; apex apiculate, subcucullate; base scarcely differentiated; margins erect, entire or irregularly notched above. *Costa* percurrent to mucronate; ventral surface bearing numerous filaments, dorsal superficial cells rectangular, smooth; in section oval, guide cells 4, ventral filaments to 8 cells high, fused at base, apical cells of filaments conical, smooth, dorsal stereid band 4 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* rounded, quadrate to short-rectangular, weakly thickened, smooth; basal cells weakly differentiated, rectangular, hyaline, thin-walled.

Dioicous or cladautoicous. Perichaetia terminal, leaves to 1 mm long. *Seta* 2,5–3,5 mm long, yellow; capsule elliptical, 1 mm long, dark red to yellowish red; peristome with basal membrane projecting above capsule mouth, to 50 μm high, teeth short, irregularly cleft, 200–300 μm high, straight, strongly papillose; operculum conic to rostrate, 0,2–0,5 mm long, cells weakly twisted counter-clockwise; spores subround, 16–23 μm, essentially smooth. Fig. 54: 1–10.



MAP 74.— ● Crossidium spiralifolium
× Crossidium apiculatum

Endemic to Southern Africa, *C. apiculatum* is found on crusts of sand under low shrubs in Namaqualand in the northwestern Cape. Map 74.

Vouchers: *Magill & Schelpe* 3881, 3890, 3891, 3892.

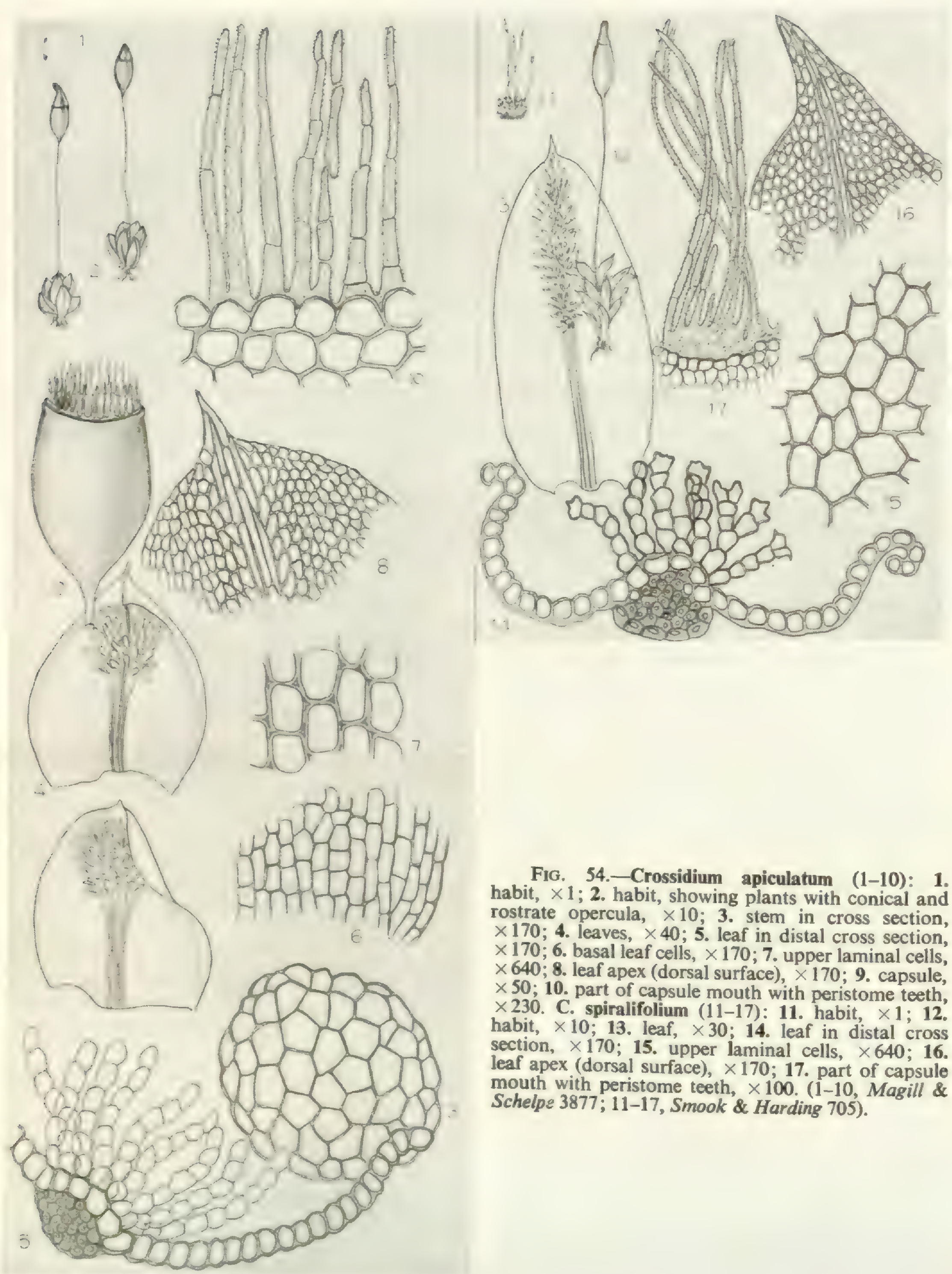


FIG. 54.—**Crossidium apiculatum** (1–10): **1.** habit, ×1; **2.** habit, showing plants with conical and rostrate opercula, ×10; **3.** stem in cross section, ×170; **4.** leaves, ×40; **5.** leaf in distal cross section, ×170; **6.** basal leaf cells, ×170; **7.** upper laminal cells, ×640; **8.** leaf apex (dorsal surface), ×170; **9.** capsule, ×50; **10.** part of capsule mouth with peristome teeth, ×230. **C. spiralifolium** (11–17): **11.** habit, ×1; **12.** habit, ×10; **13.** leaf, ×30; **14.** leaf in distal cross section, ×170; **15.** upper laminal cells, ×640; **16.** leaf apex (dorsal surface), ×170; **17.** part of capsule mouth with peristome teeth, ×100. (1–10, *Magill & Schelpe* 3877; 11–17, *Smook & Harding* 705).

Crossidium apiculatum differs from the other species of *Crossidium* by its apiculate leaf apices, smooth, conical apical cells of the costal filaments and suborbicular, appressed leaves.

2. **Crossidium spiralifolium** *Magill*, sp. nov., C. rosei *Williams foliis oblongo-lanceolatis mucronatis, cellulis apicalibus filamentorum costae subglobosis et papillosis simile, sed cellulis laminae laevibus, peristomio bene evoluto et sporibus minoribus differt.*

Type: Cape, Prieskapoort, c. 14 km from Prieska on road to Vosburg, on soil, *Smook & Harding* 705 (PRE, holo.; H; MEXU; MO; NY).

Plants small, loosely caespitose, dark green above, brownish below; terricolous. *Stems* 2 mm tall, unbranched; in section with central strand, cortical cells thin-walled, in 4–5 rows, outer row smaller, reddish. *Leaves* appressed, spirally twisted around stem dry, erect-spreading wet; oblong-lanceolate, 1,2 mm long; apex acute; base scarcely differentiated; margins narrowly revolute, entire. *Costa* mucronate; ventral surface bearing numerous filaments, dorsal superficial cells rectangular, smooth; in section subround, guide cells 6, ventral filaments 4–6 cells high, apical cells of filaments subglobose, with 2–4 papillae, filaments frequently branched above, dorsal stereid band strong, to 8 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* quadrate to angular, thin-walled, smooth; in section dorsal surface strongly thickened; basal cells weakly differentiated, quadrate to short-rectangular, hyaline, thin-walled.

Dioicous or cladautoicous. Perichaetia terminal, leaves to 1,5 mm long. *Seta* to 10 mm long, yellow; capsule cylindrical, 1,2–1,5 mm long, reddish yellow; peristome with basal membrane projecting above mouth, to 50 μm high, teeth irregularly cleft, long-filiform, 500 μm high, twisted counter-clockwise 1–2 times, yellowish red, papillose; operculum long-conic, to 0,6 mm long, cells twisted counter-clockwise; spores round to subround, 18–20 μm, weakly papillose. Fig. 54: 11–17.

Endemic to Southern Africa, this species is presently known from the shrublands of the central Cape Province and southern South West Africa/ Namibia. Map 74.

Voucher: *Hardy* 4864a.

This species differs from *C. apiculatum* in size, leaf shape and costal filament morphology. *Crossidium spiralifolium* is separated from other species of the genus by the combination of mucronate leaves, smooth leaf cells, the terminal cell of costal filaments being subglobose and papillose, and the well developed peristome.

3. PTERYGONEURUM

Pterygoneurum *Jur.*, Laubmfl. Oest. Ungarn 95 (1882), nom. cons.; Broth. in Natürl. PflFam. 10: 292 (1924); Sim, Bryo. S. Afr. 220 (1926); Wareham in Grout, Moss Fl. N. Amer. 1: 208 (1939). Type species: *P. cavifolium* Jur.

Plants small, forming dense cushions, dark green; saxicolous. *Stems* simple; central strand absent. *Leaves* lingulate; apex obtuse, subcucullate; margins broadly involute. *Costa* short-excurrent; ventral surface bearing high, plate-like, chlorophyllous lamellae. *Laminal cells* quadrate, smooth.

Autoicous. Perichaetia terminal; capsule exserted, subglobose; peristome rudimentary or absent; operculum short-rostrate; calyptra cucullate, large; spores large, papillose.

The 8 species of *Pterygoneurum* are mostly restricted in distribution. Three species occur sporadically in the Northern Hemisphere and one of these also reaches Australia. Four other species are known from Africa, 3 from the northern part of the continent and 1 is endemic to Southern Africa.

Pterygoneurum macleanum *Warnst.* in Hedwigia 58: 69 (1916); Broth. in Natürl. PflFam. 10: 292 (1924); Sim, Bryo. S. Afr. 220 (1926). Type: Cape, Graaff-Reinet, *MacLea* sub *Rehmann* 461 (PRE!).

Plants small, in dense cushions, olive-green, brownish below; saxicolous. *Stems* to 5 mm high, simple; in section round, central strand absent, but central cells often coloured, cortical cells lax, somewhat thickened at

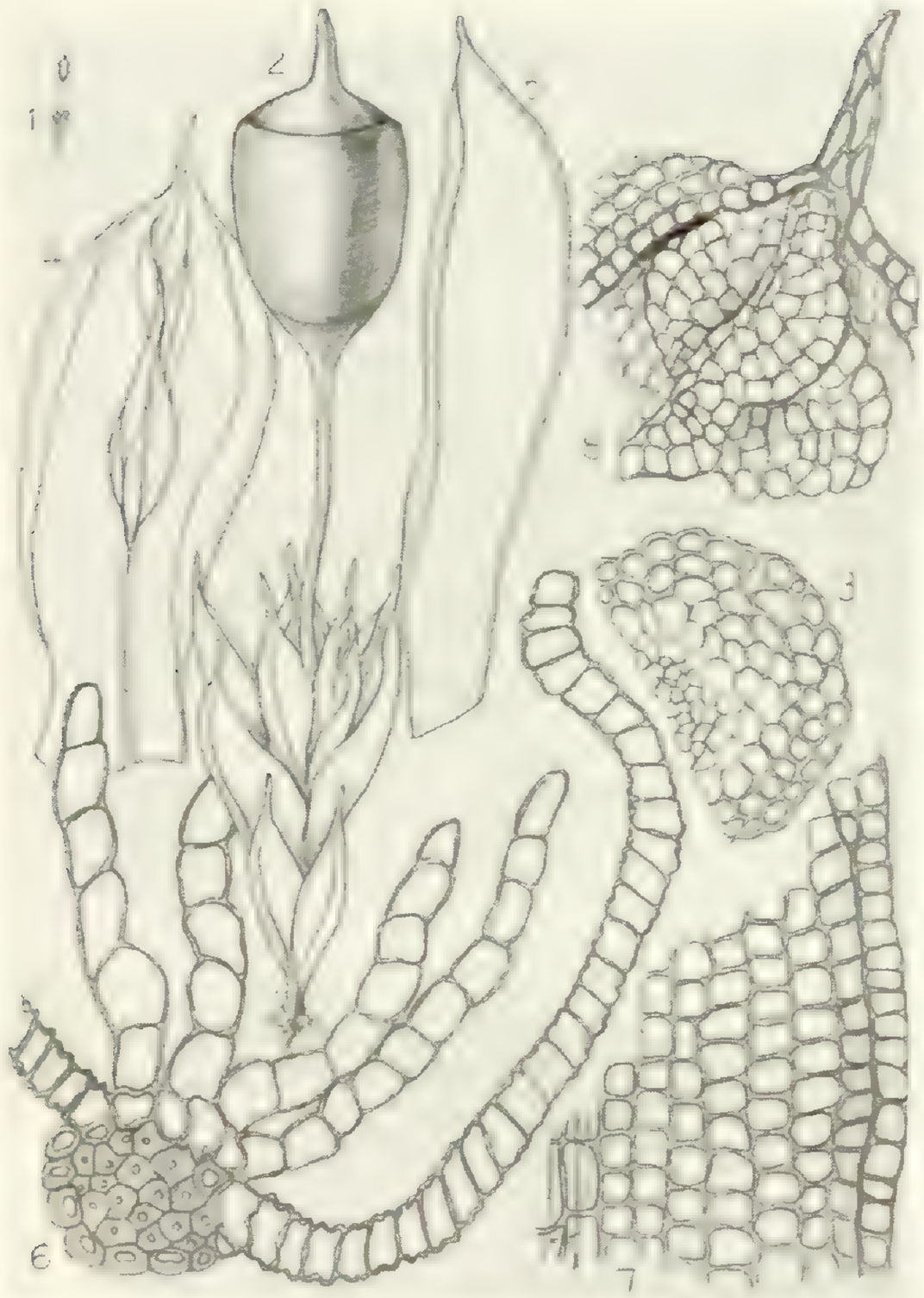


FIG. 55.—**Pterygoneurum macleanum: 1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×100; **4–5.** leaves, ×40; **6.** leaf in distal cross section, ×240; **7.** cells at leaf base, ×170; **8.** leaf apex, ×170. (1–8, *Rehmann* 461).

margins. *Leaves* incurved-appessed or slightly contorted dry, erect wet; lingulate to ovate-lingulate, 1,0–1,5 mm long; apex obtuse; margins broadly involute above. *Costa* short-excurrent to mucronate; ventral surface with 4 high, undulate lamellae, dorsal superficial cells long-rectangular, strongly incrassate; in section subround, guide cells 4, each bearing a plate-like lamella, to 16 cells high, dorsal stereid band to 6 cells thick, dorsal surface cells substereids. *Upper laminal cells* quadrate, incrassate, smooth; basal cells similar or slightly larger, thin-walled; lamellae cells quadrate, thin-walled, chlorophyllous.

Autoicous. Perichaetial leaves undifferentiated. *Seta* 1,0–1,2 mm long, yellowish; capsule subglobose, to 1 mm long, gymnostomous; operculum rostrate, to 0,7 mm long; calyptra cucullate, 2 mm long, covering capsule; spores large, 35–38 μm, papillose. Fig. 55: 1–8.

Endemic to Southern Africa, the species is known from the semi-arid shrublands of the central Cape Province. Map 73.

Voucher: Type only.

Pterygoneurum macleanum bears some resemblance to species of *Crossidium* but can be distinguished from them by the plate-like lamellae and gymnostomous capsule. Ventral costal lamellae are also known in *Acaulon* and several genera of the Polytrichaceae.

4. ACAULON

Acaulon *C. Müll.* in Bot. Ztg 5: 99 (1847); Broth. in Natürl. PflFam. 10: 283 (1924); Scott & Stone, Moss. S. Aust. 176 (1976). Type species: *A. muticum* (Hedw.) C. Müll.

Plants very small, bulbiform, hyaline or reddish green, gregarious; growing on sand or clay. *Stems* simple; central strand absent. *Leaves* imbricate wet or dry, concave; broadly oval to obovate; apex acute, frequently hyaline; margins plane or revolute, entire or dentate at apex. *Costa* aristate, hyaline or reddish; in section round, guide cells 2, ventral cells present or absent, sometimes producing plate-like lamellae, dorsal cells stereids or substereids. *Laminal cells* quadrate, rhomboidal or hexagonal, smooth or infrequently weakly papillose; basal cells rectangular.

Paroicous or autoicous. *Perichaetial leaves* ± larger, similar to upper leaves. *Seta* very short; capsule cleistocarpic, immersed, globose-apiculate; exothecial cells of various shapes, irregularly arranged; calyptra minute, mitrate; spores round, granulate to minutely spinose.

The 18 species of *Acaulon* are infrequently collected in temperate regions of both hemispheres. In Southern Africa the genus is known from the arid and semi-arid regions of the western Cape and South West Africa/Namibia. The genus is closely related to *Phascum* and differences between the two are discussed there.

1 Plants green to reddish green; leaf awn reddish yellow..... 3. *A. rufochaete*
1 Plants hyaline above, light green below; leaf awns hyaline:
2 Upper ventral costal surface with short plate-like lamellae, 2–6 cells high; leaf margins plane..... 1. *A. leucochaete*
2 Upper ventral costal cells enlarged, swollen, not forming lamellae; leaf margins revolute..... 2. *A. recurvatum*

1. **Acaulon leucochaete** *Stone* in J. Bryol. 9: 217 (1976). Type: Australia, Victoria, Boundary Bend, *Stone* 1548b (MEL, holo.; MELU; BM).

Plants small, hyaline above, light green below; terricolous. *Stems* 0,2–0,3 mm tall; in section round, central strand absent or with 1–3 smaller cells, cortical cells lax, reddish toward margin. *Leaves* imbricate and with flexuose awns wet or dry, concave; broadly oval to oblong, 0,5–1,0 mm long; apex acute, hyaline; margins plane, entire below, irregularly dentate near apex. *Costa* long-excurrent as a smooth, hyaline awn, to 1 mm long in upper leaves; upper ventral surface with lamellae, dorsal superficial cells rectangular, smooth; in section round, guide cells 2, ventral, each bearing a short, plate-like lamella, 2–6 cells high, dorsal stereid band 2 cells thick, cells frequently substereids, dorsal surface cells substereids, outer walls strongly thickened. *Upper laminal cells* rhomboidal to hexagonal, thin-walled, smooth; marginal cells narrower, forming weak border in upper leaf; basal cells rectangular.

Paroicous. Perichaetial leaves not differentiated. *Seta* very short, 0,2–0,3 mm long; capsule cleistocarpic, globose with minute apiculus, to 1 mm long, reddish yellow; exothecial cells quadrate to short-rectangular; calyptra small, mitrate; spores round, 23–25 μm, strongly incrassate, granulate to almost smooth, frequently with 3–4 large oil bodies. Fig. 56: 1–11.

Acaulon leucochaete is known from Australia and Southern Africa. Growing under low shrubs on sandy or clay soils, specimens have recently been collected in the succulent shrublands, between Clanwillian and Springbok, in the northwestern Cape. Map 75.

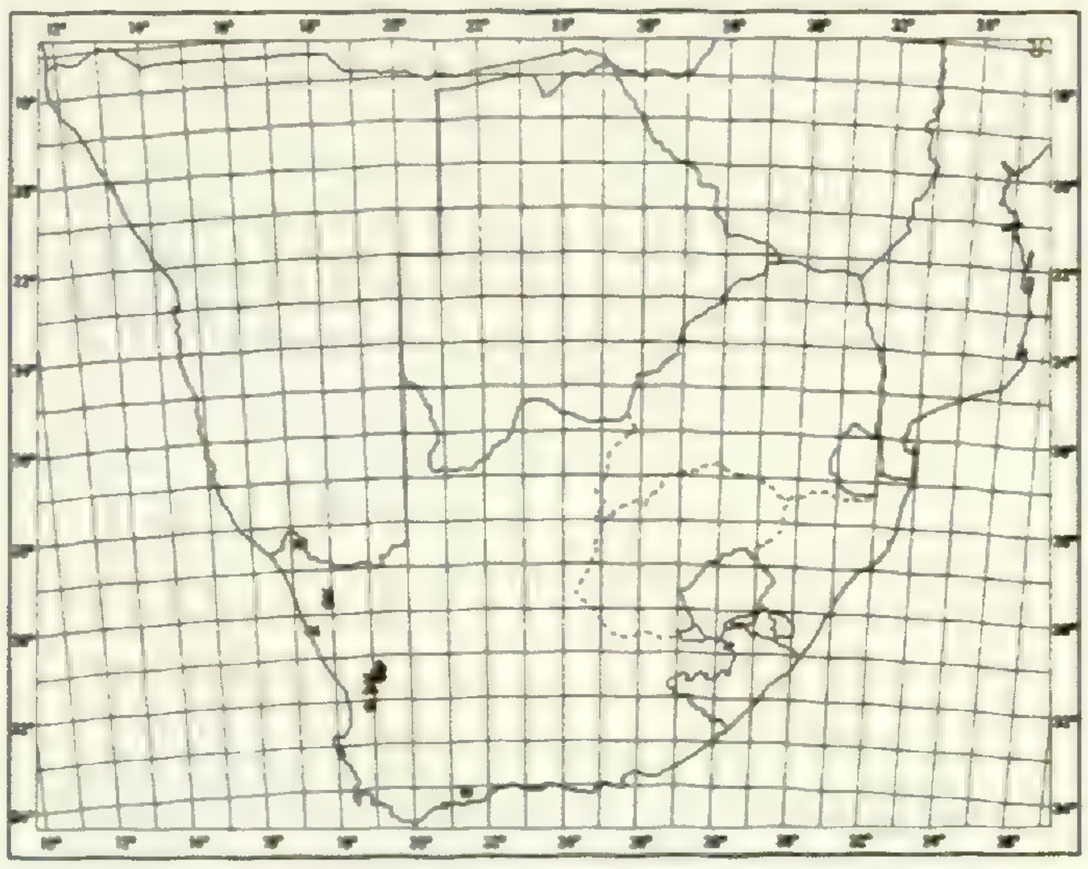
Vouchers: *Magill & Schelpe* 3883, 3895, 3914; *Schelpe* 7766.

This species was recently described from Boundary Bend in Victoria, Australia, by Stone (1976) along with a closely related species, *A. chrysacanthum* Stone. The presence of *A. leucochaete* in Southern Africa is a clear indication of the close relationship of the two bryofloras. *Acaulon leucochaete* is separated from the other species by ventral costal lamellae and plane leaf margins.

2. **Acaulon recurvatum** *Magill*, sp. nov., *habitu et colore* A. leucochaete *Stone simile, sed marginibus foliorum integris, reflexis ad revolutis, cellulis laminae infirme papillosis, et cellulis ventralibus superficialibus costae amplificatis papillosis differt.*

Type: Cape, Namaqualand, Springbok, on soil 10 km E of Springbok, on Pofadder Road, *Schelpe* 7717 (BOL, holo.; MO; PRE).

Plants small, hyaline above, yellow-green below; terricolous. *Stems* 0,1–0,2 mm tall; in section without central strand, cortical cells lax, marginal cells reddish brown. *Leaves* imbricate with contorted awns wet or dry, concave; broadly oval to obovate, 1,0–1,5 mm long; apex acute, frequently hyaline; margins revolute above base, entire to denticulate. *Costa* excurrent as long, smooth, hyaline awn, 0,5–0,8 mm in upper leaves; ventral superficial cells lax, bulging, quadrate to short-rectangular, with 1–2 weak papillae, dorsal superficial cells elongate, smooth; in section round, guide cells indistinct, ventral surface cells enlarged, swollen, 4–6 cells in single row, papillose, dorsal stereid band 5–6 cells thick, some cells substereids, dorsa



MAP 75.— ● Acaulon recurvatum
× Acaulon leucochaete
▲ Acaulon rufochaete

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surface cells undifferentiated. *Upper laminal cells* quadrate, incrassate, smooth; median leaf cells quadrate to hexagonal, finely papillose, with 1–3 C- or O-shaped papillae over dorsal lumen; basal cells larger, short-rectangular.

Paroicous. Perichaetial leaves broader; margins reflexed to revolute; apical cells smooth, rhomboidal, hyaline, thin-walled. *Seta* to 0,3 mm long; capsule cleistocarpic, globose-apiculate, 0,9–1,0 mm long, reddish yellow; exothecial cells short-rectangular to quadrate; calyptra minute, mitrate, 0,4 mm long; spores round, 22–25 μm, granulate. Fig. 56: 12–18.

Endemic to Southern Africa, this species occurs in the succulent Karoo of Namaqualand, in the north-western Cape and fynbos of the southern and south-western Cape. Map 75.

Voucher: *Magill & Schelpe* 4046; *Muir* 3779a.

Similar to *A. leucochaete*, but differs in the enlarged, papillose, ventral superficial cells of the costa and the absence of lamellae. The upper leaf margins also differ in being entire and reflexed to revolute.

3. **Acaulon rufochaete** *Magill*, sp. nov., *habitu et colore* A. chrysacantho *Stone simile, sed foliis marginibus recurvatis, costa sine lamellis ventralibus, cellulis laminae interdum subtiliter papillosis et sporis majoribus differt.*

Type: Cape, Knersvlakte, on soil 6 km NE of Vanrhynsdorp, near turnoff to Kobee, *Magill & Schelpe* 3877c (PRE, holo.; BOL; H; MO; NY).

Plants very small, scattered, green to reddish green; terricolous. *Stems* 0,1–0,2 mm tall; in section without central strand, cortical cells lax. *Leaves* imbricate dry, imbricate with erect apices and reflexed awns wet; broadly oval to oblong, 0,8–1,5 mm long; apex acute, chlorophyllous; margins revolute above, entire. *Costa* excurrent as smooth, reddish yellow awn, 0,1–0,5 mm long, ventral and dorsal superficial cells rectangular, smooth; in section round, guide cells exposed ventrally, 2–4, weakly thickened, dorsally cells incrassate, 2–4 cells thick. *Upper laminal cells* quadrate, rhomboidal or short-rectangular, thin-walled or weakly thickened, smooth or rarely with 1–2 minute, blunt papillae over lumen; basal cells short-rectangular, thin-walled, smooth.

Autoicous. Perichaetial leaves oblong to oval, acute, concave; costa excurrent, reddish; laminal cells short-rectangular to rhombic. *Seta* 0,1–0,2 mm long; capsule cleistocarpic, globose-apiculate, 0,5 mm long, reddish yellow, darker above; exothecial cells triangular, rectangular or angular-elongate; calyptra minute, mitrate, 0,3 mm long; spores round, 37–42 μm, minutely spinose. Fig. 56: 19–25.

Presently known only from the western Cape, the species is infrequently collected on sandy soil under low shrubs between Clanwilliam and Vanrhyns Pass. Map 75.

Vouchers: *Magill & Schelpe* 3878, 3897, 3912.

This species is recognized by its long reddish awn, more or less smooth leaf cells and large, minutely spinose spores.

Insufficiently Known Species

Acaulon capense C. Müll. in Bot. Ztg 14: 415 (1856). *Sphaerangium capense* (C. Müll.) Jaeg. in Verh. St Gall. naturw. Ges. 1871–72: 336 (1873). Type: Cape, Swellendam, *Pappe* s.n. The type has not been seen. Sim (1926) referred this species to *A. muticum* (Hedw.) C. Müll. without seeing Pappe's specimen.

Acaulon sphaericum Shaw in Cape Monthly Mag. 17: 313 (1878). Type: Cape, Graaff-Reinet, *McLea* s.n. Sim (1926) refers this species to *A. muticum* (Hedw.) C. Müll. without having seen the type; however, the description could also apply to an *Ephemerum* species. The Sim correspondence (PRE) indicates that the Shaw collection was destroyed sometime after his death. Attempts to locate the specimens in Southern Africa have been unsuccessful and duplicates were not located in the European herbaria likely to house Shaw specimens.

FIG. 56.—**Acaulon leucochaete** (1–11): **1.** habit, ×1; **2.** habit, ×20; **3.** stem in cross section, ×100; **4.** lower stem leaf, ×40; **5.** upper leaves, ×40; **6.** leaf in distal cross section, ×170; **7.** basal leaf cells, ×170; **8.** cells at leaf apex (dorsal surface), ×170; **9.** capsule with calyptra, ×40; **10.** exothecial cells and stomata at capsule base with spores, ×80; **11.** spore, ×400. **A. recurvatum** (12–18): **12.** habit, ×1; **13.** habit, ×20; **14.** leaves, ×40; **15.** leaf in distal cross section, ×170; **16.** upper laminal cells, ×400; **17.** cells at leaf apex (dorsal surface), ×170; **18.** spore, ×500. **A. rufochaete** (19–25): **19.** habit, ×1; **20.** habit, ×20; **21.** leaves, ×40; **22.** leaf in distal cross section, ×170; **23.** upper laminal cells, ×400; **24.** cells at leaf apex (dorsal surface), ×170; **25.** perichaetial leaf, ×40. (1–11, *Magill & Schelpe* 3900; 12–18, *Schelpe* 7717; 19–25, *Magill & Schelpe* 3912).

5. PHASCUM

Phascum *Hedw.*, Spec. Musc. 19 (1801); Broth. in Natürl. PflFam. 10: 284 (1924); Sim, Bryo. S. Afr. 218 (1926); Grout, Moss Fl. N. Amer. 1: 195 (1939). Lectotype species: *P. cuspidatum* Hedw., vide Grout, Moss Fl. N. Amer. 1: 195 (1939).

Plants small, gregarious or in small groups, yellowish green to reddish green; terricolous. *Stems* to 5 mm high, generally smaller; central strand absent. *Leaves* little contorted dry, erect to erect-spreading wet; obovate, oblong or oval; apices acute; margins plane or revolute, entire or serrate. *Costa* short- or long-excurrent, smooth; in section with dorsal stereid or substereid band only. *Laminal cells* hexagonal, quadrate or rectangular, smooth or finely papillose.

Autoicous. Capsule cleistocarpic, emergent or exserted, elliptical, rostrate; calyptra cucullate; spores round to oval, almost smooth or verruculate.

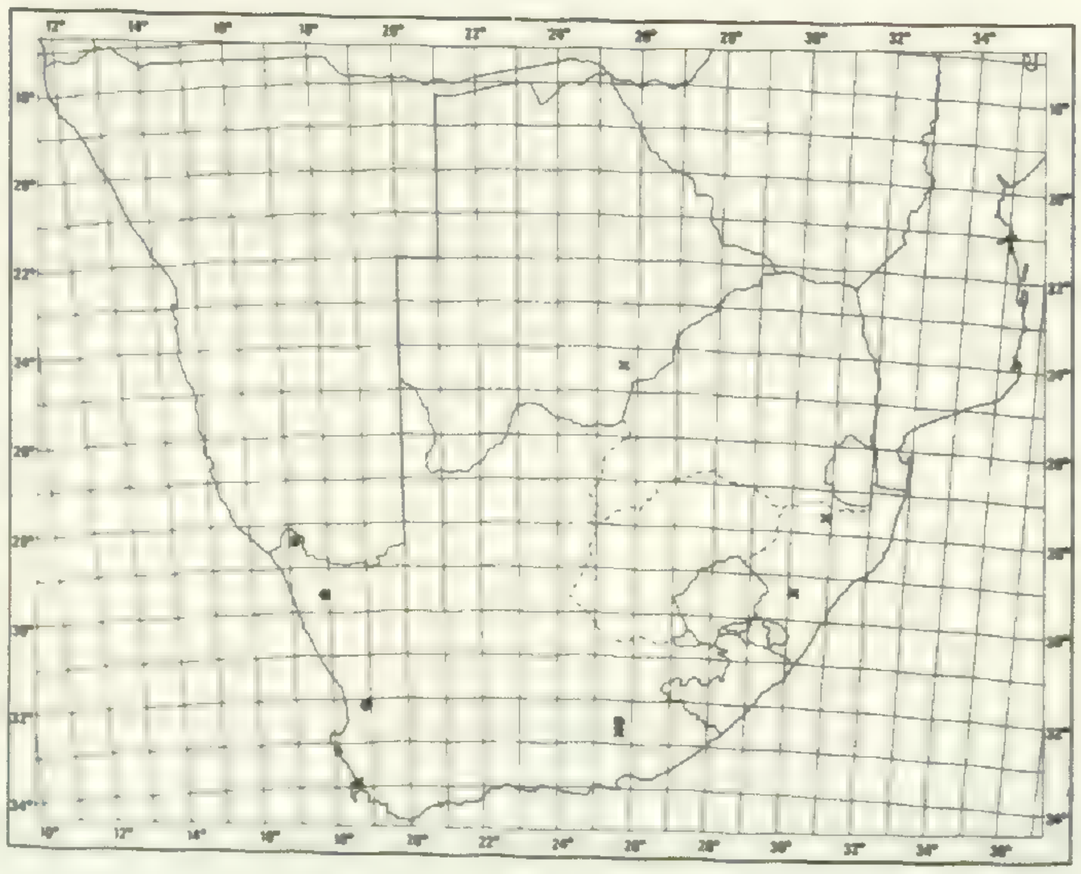
A genus of c. 20 species, *Phascum* is widespread although uncommon in temperate regions. In Southern Africa the genus is best represented in the drier areas of the western Cape and southern South West Africa/ Namibia. *Phascum leptophyllum* is known from more mesic locations in the eastern Cape, eastern Transvaal and Zimbabwe.

The genus is closely related to *Acaulon* and the two genera are frequently collected together in Namaqualand. The classic diagnostic characters appear to overlap in Southern African species, as is the case in Australia, (Scott & Stone, 1976). The size of the capsule beak, curvature of leaf margin and papillosity of leaf cells, although useful characters, will not easily separate Southern African taxa. *Phascum* is defined here by its narrower, generally plane-margined, erect or spreading leaves, and its emergent capsule and cucullate calyptra. The leaves of the Southern African species of *Acaulon* are broad, concave and enclose the capsule, giving a bulbiform appearance to the plants. The calyptra is very small and mitrate.

1 Plants 2–5 mm tall; leaf margins irregularly serrate; costa short-excurrent ..... 2. *P. leptophyllum*
1 Plants generally less than 1 mm tall; leaf margins entire; costa excurrent as a long, reddish or yellowish awn ..... 1. *P. peraristatum*

1. **Phascum peraristatum** *C. Müll.* in Flora, Jena 71: 3 (1888); Broth. in Natürl. PflFam. 10: 284 (1924). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1882.

Plants small, gregarious, reddish green; terricolous. *Stems* erect, 0,5–1,0 mm tall; in section without central strand, cortical cells large, weakly thickened, smaller at margin, yellowish red. *Leaves* erect dry, erect-spreading wet; oblong-obovate to oval, 0,8–1,2 mm long; apex acute, sometimes abruptly so; margins revolute above base, entire. *Costa* excurrent, awn 0,1–1,0 mm long, reddish to yellowish; ventral superficial cells quadrate, papillose to near apex, absent above and exposing elongate, smooth cells, dorsal superficial cells elongate, smooth; in section round, guide cells 2, small, incrassate, ventral cells in single layer, 2–4, large, papillose, dorsal stereid band 3 cells thick, dorsal surface cells frequently substereids. *Upper laminal cells* quadrate to subhexagonal, sometimes short-rectangular, with 2–6 low, C-shaped papillae over lumen, rarely smooth; basal cells larger, quadrate to rectangular or some angular, smooth.



MAP 76.— ● **Phascum peraristatum**
× **Phascum leptophyllum**

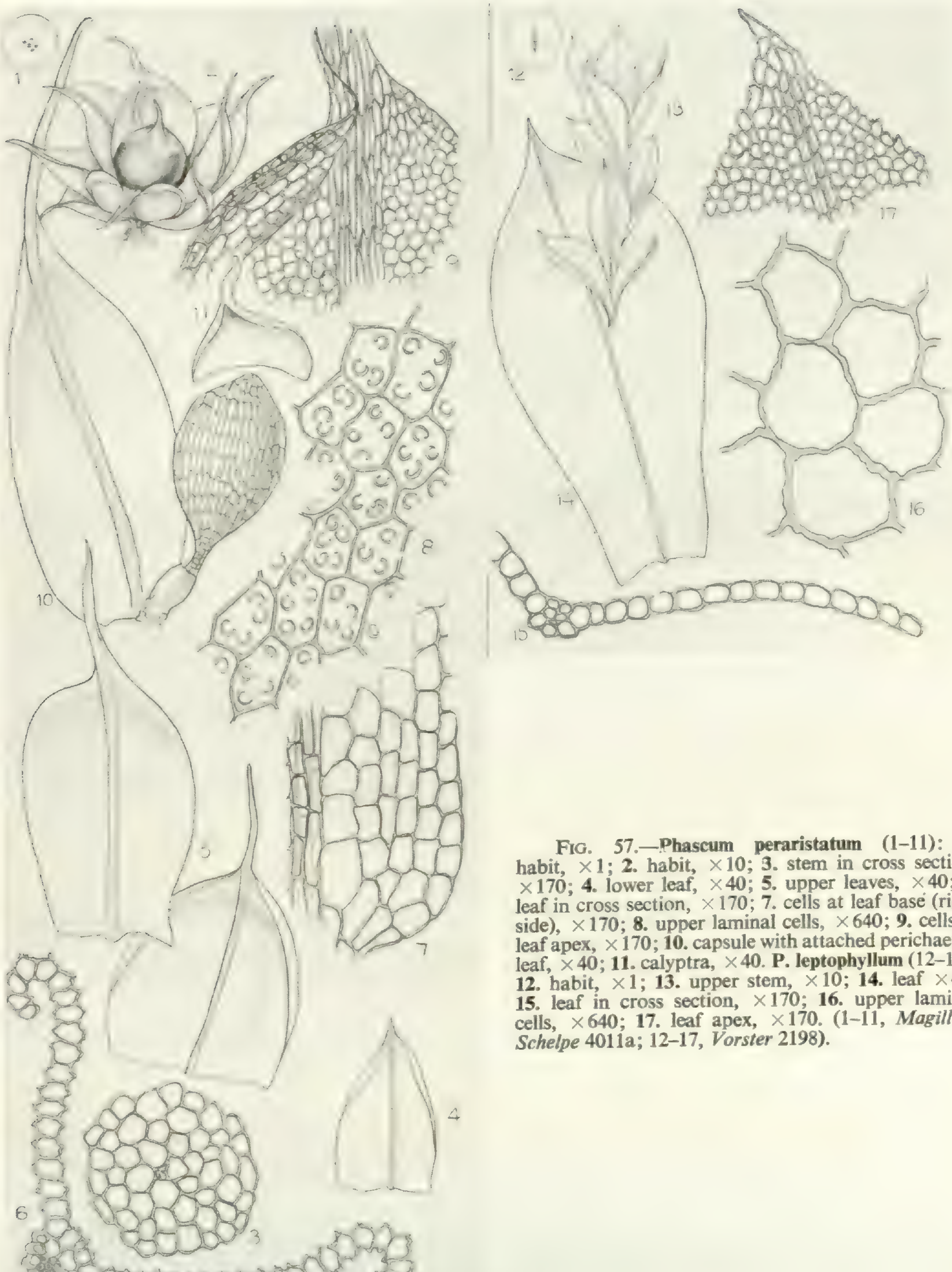


FIG. 57.—**Phascum peraristatum** (1–11): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×170; **4.** lower leaf, ×40; **5.** upper leaves, ×40; **6.** leaf in cross section, ×170; **7.** cells at leaf base (right side), ×170; **8.** upper laminal cells, ×640; **9.** cells at leaf apex, ×170; **10.** capsule with attached perichaetial leaf, ×40; **11.** calyptra, ×40. **P. leptophyllum** (12–17): **12.** habit, ×1; **13.** upper stem, ×10; **14.** leaf ×40; **15.** leaf in cross section, ×170; **16.** upper laminal cells, ×640; **17.** leaf apex, ×170. (1–11, *Magill & Schelpe* 4011a; 12–17, *Vorster* 2198).

Autoicous, frequently polysetaceous. Perichaetial leaves undifferentiated. *Seta* very short, 0,2–0,3 mm long; capsule cleistocarpic, emergent, reddish yellow, short-elliptical to subglobose, rostrate, 0,4–0,5 mm long, exothecial cells quadrate at apex and base, median cells narrowly oblong to triangular; calyptra cucullate, small, 0,4 mm long; spores round to oval, 25–33 μm, smooth to irregularly granulate. Fig. 57: 1–11.

Originally described from the eastern Cape Province, *P. peraristatum* has recently been found at several locations in the dry shrublands of the western Cape. Map 76.

Vouchers: *Magill & Schelpe* 4011a; *Schelpe* 7765, 7781.

This species may be confused, vegetatively, with *Acaulon*. Sporophytically, *P. peraristatum* is distinct in the exposed, elliptical-rostrate capsules, differentiated exothecial cells and cucullate calyptra.

The species was described as having smooth leaf cells, however all subsequent collections examined from Southern Africa, have several fine, C-shaped papillae on the upper laminal cells. Since these papillae were detected on specimens mounted in Hoyer's medium, it was believed that the papillae had been overlooked when the species was described. Unfortunately the type has not been located.

A specimen recently examined from Kenya (Comm. Townsend, 1981) is similar to the Southern African specimens except that it has smooth leaf cells. It may, therefore be more similar to MacOwan's collection than the papillose specimens from the western Cape. The taxon is considered to include both "facies", however the papillose specimens may represent an undescribed variety.

2. **Phascum leptophyllum** *C. Müll.* in Flora, Jena 71: 6 (1888); Broth. in Natürl. PflFam. 10: 284 (1924); Sim, Bryo. S. Afr. 218 (1926). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1882.

Plants small, gregarious, light green; terricolous. *Stems* 2–5 mm high; in section round, central strand absent, cortical cells lax, outer row smaller. *Leaves* somewhat distant, weakly contorted dry, erect-spreading wet; narrowly elliptical to obovate, 1,5–3,0 mm long; apex acute; margins plane, irregularly crenulate to serrate above base. *Costa* short-excurrent; ventral and dorsal superficial cells short-rectangular, smooth; in section round, guide cells 2, small, thickened, ventral surface cells 2, thin-walled, bulging, dorsal cells weakly incrassate, 3 cells thick. *Upper laminal cells* hexagonal to subhexagonal, quadrate or rectangular, smaller toward margin, smooth; basal cells quadrate to short-rectangular.

Sporophyte not seen, but described by Müller as: *Seta* short; capsule emergent, turgid-elliptical with distinct, oblique beak, brownish. Fig. 57: 12–17.

Phascum leptophyllum was described from Somerset East in the shrublands of the central Cape Province. Sim made additional collections from Victoria Falls, Zimbabwe, and more recently specimens have been collected in Botswana, Natal and the south-western Cape. Map 76.

Vouchers: *Sim* 8771, 8857; *Magill* 5062; *Van Zanten* 7608116.

The plants are very large for *Phascum* and may be more properly placed in *Pottia*. Additional sporophytes must be found in order to assess proper generic position.

6. POTTIA

Pottia (*Reichenb.*) *Fuernr.* in Flora, Jena 12 (2 Erg.): 10 (1829); Broth. in Natürl. PflFam. 10: 289 (1924); Wareham in Grout, Moss Fl. N. Amer. 1: 197 (1939); Sim, p.p., Bryo. S. Afr. 219 (1926). Lectotype species: *P. truncata* (Hedw.) B.S.G., vide Wareham ex Grout, Moss Fl. N. Amer. 1: 197 (1939).

Plants small to minute, gregarious or in loose cushions, yellowish, reddish or dark green; terricolous. *Acaulescent* or stems to 2 mm tall; central strand absent or not well defined,

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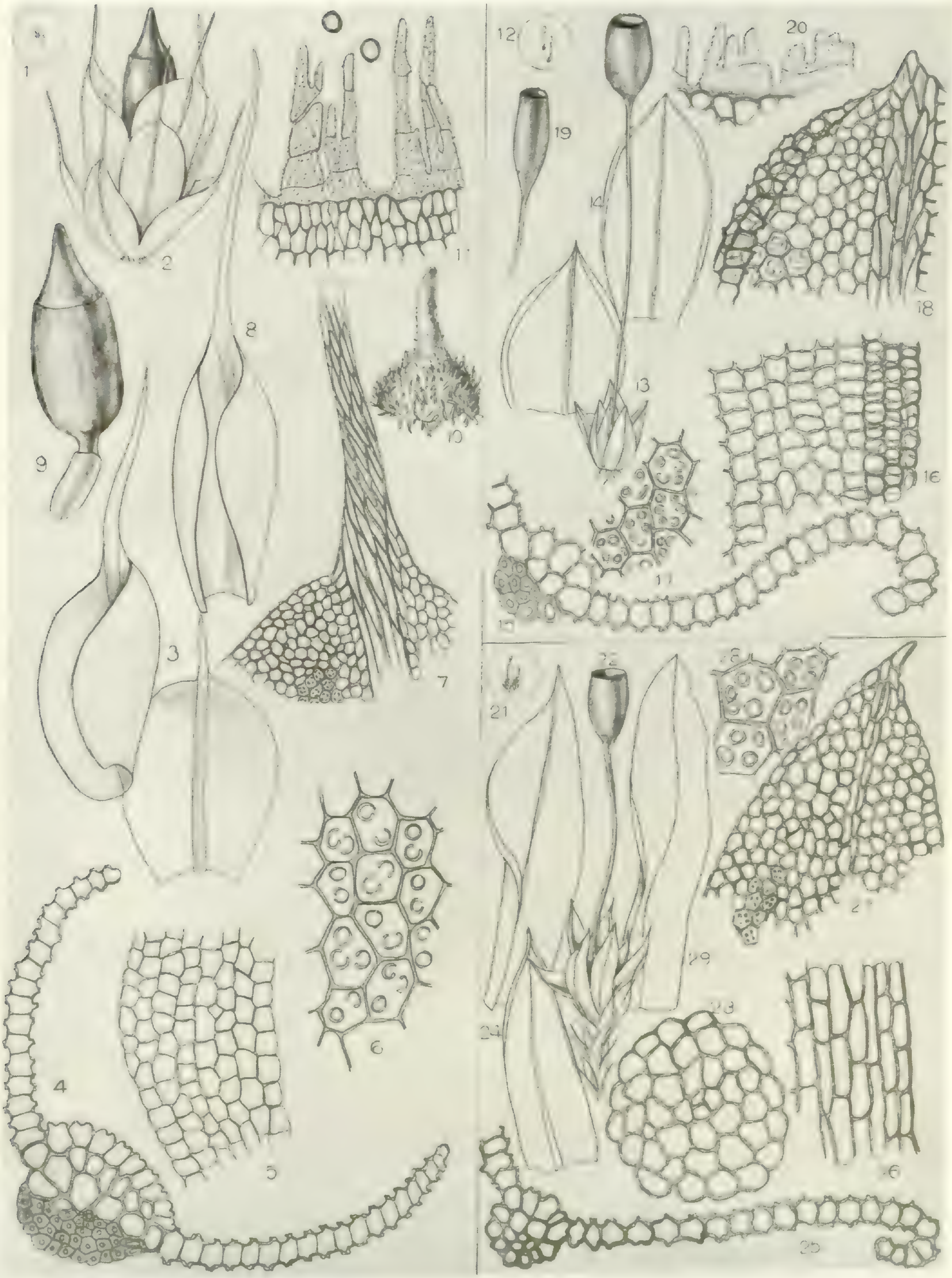
FIG. 58.—**Pottia namaquensis** (1–11): **1.** habit, ×1; **2.** habit, ×20; **3.** leaves, ×40; **4.** leaf in cross section, ×230; **5.** basal leaf cells, ×170; **6.** upper laminal cells, ×640; 7. cells at leaf apex, ×170; **8.** perichaetial leaf, ×40; **9.** capsule, ×30; **10.** calyptra, ×30; **11.** part of capsule mouth with peristome teeth and spores, ×175. **P. macowaniana** (12–20): **12.** habit, ×1; **13.** habit, ×20; **14.** leaves, ×40; **15.** leaf in cross section, ×230; **16.** basal leaf cells (dorsal surface), ×170; **17.** upper laminal cells, ×370; **18.** leaf apex (left dorsal side), ×170; **19.** capsule, ×20; **20.** part of capsule mouth with peristome teeth, ×250. **P. subplanomarginata** (21–29): **21.** habit, ×1; **22.** habit, ×10; **23.** stem in cross section, ×230; **24.** leaves, ×40; **25.** leaf in cross section, ×230; **26.** basal leaf cells, ×170; **27.** leaf apex, ×170; **28.** upper laminal cells, ×640; **29.** perichaetial leaf, ×40. (1–11, *Oliver* 7208; 12–20, *Magill* 3888c; 21–29, *Wager* 1570c).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cortical cells lax. *Leaves* erect to spreading wet; oval, ovate or oblong; apex acute to obtuse; margins plane, erect or revolute. *Costa* subpercurrent to long-excurrent; in section guide cells small, ventral surface cells similar to laminal cells, dorsal stereid band small. *Laminal cells* quadrate, hexagonal or rectangular, finely papillose; basal cells generally larger, quadrate to rectangular.

Autoicous. Perichaetia terminal, leaves undifferentiated. *Capsule* stegocarpic or cleistocarpic, emergent or exserted, oval to ovate or short-cylindrical, peristome absent or, when present, rudimentary, consisting of short, cleft or perforated teeth, frequently only lower base of teeth present, finely papillose, yellowish; operculum conic; calyptra cucullate; spores round to angular, smooth, granulate or verruculate.

The genus is widely distributed in temperate regions, although the c. 60 species tend to be restricted in their individual distributions. In Southern Africa, *Pottia* is known only from the Cape and southern South West Africa/Namibia. The four species are rarely collected, and occur on sandy soil in association with other ephemeral species of *Acaulon*, *Phascum*, *Aloina* and *Crossidium*.

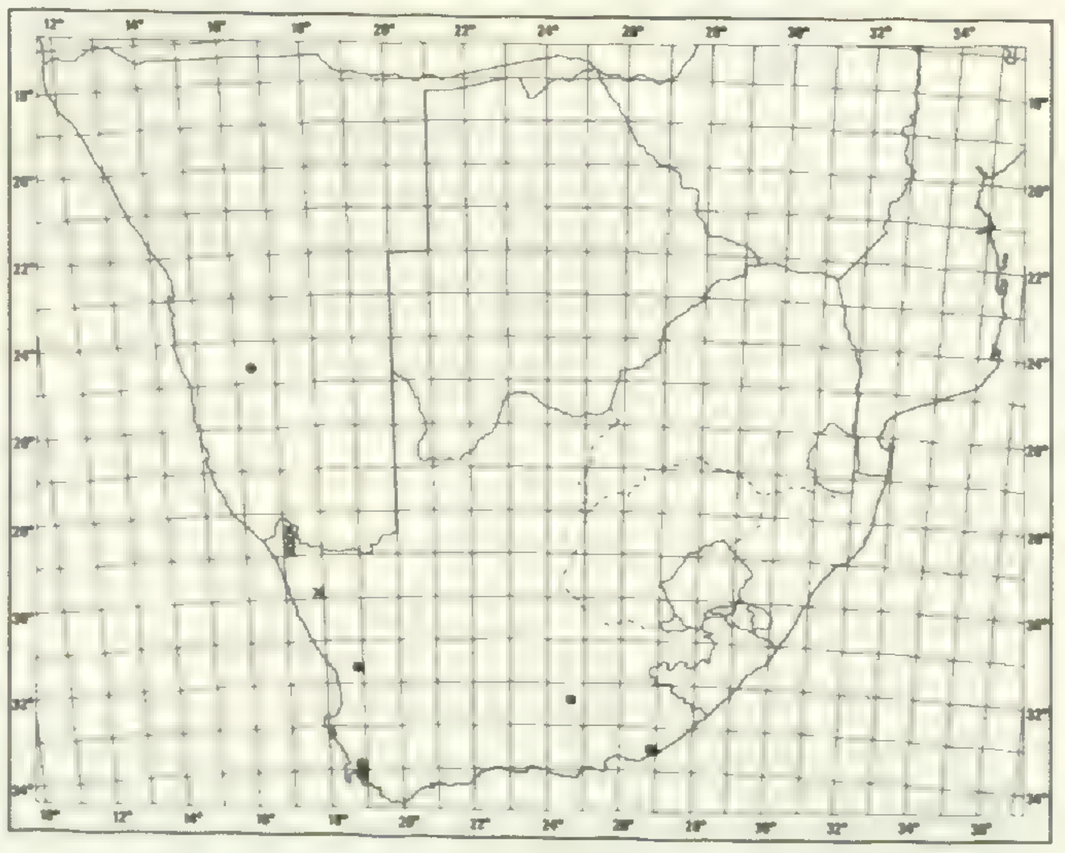
1 Costa long-excurrent; peristome developed ..... 1. *P. namaquensis*
1 Costa short-excurrent or percurrent; peristome absent or rudimentary:
  2 Capsule cleistocarpic; costa percurrent; leaves oblong to lingulate ..... 4. *P. splachnoides*
  2 Capsule stegocarpic, peristome rudimentary; costa short-excurrent:
    3 Leaves oblong-lanceolate to oblong-elliptical; plants in loose groups; spores granulate, 25–32 μm ..... 3. *P. subplanomarginata*
    3 Leaves broadly ovate to oval; plants gregarious; spores verruculate, 17–22 μm .... 2. *P. macowaniana*

1. **Pottia namaquensis** *Magill*, sp. nov., *in genera bene distinta speciebus ceteris* Pottiae (*Reichenb.*) *Fuernr.*, *capsula emergente*, *parva cylindracea*, *calyptra scabrosa*, *seta minima et foliis late ovalibus costis longe excurrentibus dignoscenda*.

Type: Cape, Namaqualand, Messelpad Road between Taaiboskraal and Nuweputs, south slope, damp, open ground, *Oliver* 7208 (PRE, holo.; MO).

Plants very small, acaulescent or nearly so, 1–2 mm high, bulbiform, dark green, gregarious; terricolous. *Leaves* appressed dry, erect-spreading wet, concave; broadly oval, 0,5–1,0 mm long; apex rounded; margins plane, entire. *Costa* long-excurrent as a smooth, hyaline awn, to 1 mm long; ventral superficial cells quadrate, papillose, dorsal superficial cells long-rectangular, smooth; in section with 4 large guide cells, ventral cells in two rows, inner cells smaller than guide cells, surface cells similar to laminal cells, papillose, dorsal stereid band 4–5 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* quadrate to subhexagonal, papillae 1–3 per cell, C- or O-shaped; basal cells quadrate, larger, smooth, hyaline.

Dioicous. Perichaetial leaves clasping capsule; elliptical, 2 mm long including awn. *Seta* very short, to 0,3 mm long; capsule emergent, short-cylindrical, 0,6 mm long; exothecial cells rectangular, cells at mouth narrow, vertically elongate, in 1–3 rows; peristome short, 0,15 mm high, somewhat irregular, teeth triangular, cleft or perforated,



MAP 77.— ● **Pottia subplanomarginata**
× **Pottia namaquensis**

above, papillose; operculum rostrate, 0,4 mm long; calyptra broadly conic, long-rostrate, 0,7 mm long, spinose or with short hairs; spores round, 17–18 μm, smooth. Fig. 58: 1–11.

Endemic to Southern Africa, *P. namaquensis* was collected in the dwarf succulent shrublands of Namaqualand and the Richtersveld in the northwestern Cape. Map 77.

Vouchers: *Oliver, Tölken & Venter* 651a, PRE-CH12888, PRE-CH12897.

The species is recognized by the very short stem, the broadly oval, aristate leaves and emergent, short-cylindrical capsule.

2. **Pottia macowaniana** *C. Müll.* in Hedwigia 38: 98 (1899); Broth. in Natürl. PflFam. 1: 423 (1902); Sim, Bryo. S. Afr. 219 (1926). Type: Cape, Small Fish River, *MacOwan* s.n., 1878.

?*Pottia verrucosa* Rehm. ex Warnst., p.p., in Hedwigia 58: 140 (1916). Type: Cape, Graaff-Reinet, *McLea* sub *Rehmann* 460 (B).

Plants minute, gregarious, green; terricolous. *Stems* to 0,5 mm tall; in section central cells very thin-walled, cortical cells lax. *Leaves* imbricate dry, patent wet; broadly ovate to oval, 0,8–1,8 mm long; apex obtuse to rounded, mucronate to apiculate; margins revolute above base, entire. *Costa* short-excurrent, smooth; ventral superficial cells quadrate to short-rectangular, papillose, dorsal superficial cells rectangular, smooth; in section round, guide cells 2, small, ventral surface cells similar to lamina cells, papillose, dorsal stereid band 2–4 cells thick, dorsal surface cells substereids, sometimes lateral cells larger, papillose. *Upper laminal cells* quadrate to hexagonal, some short-rectangular, papillose, 2–4 C-shaped papillae over lumen; basal cells larger, rectangular to quadrate, smooth.

Autoicous. Antheridia axillary on upper stem; perichaetia terminal, leaves undifferentiated. *Seta* 2,0–3,5 mm long, yellowish; capsule cylindrical to oval, 1,0–1,2 mm long; peristome rudimentary, exserted above mouth, light yellow, faintly papillose; operculum short-conic; calyptra cucullate, to 1–2 mm long; spores irregular, rounded to triangular, 17–22 μm, weakly verruculate. Fig. 58: 12–20.

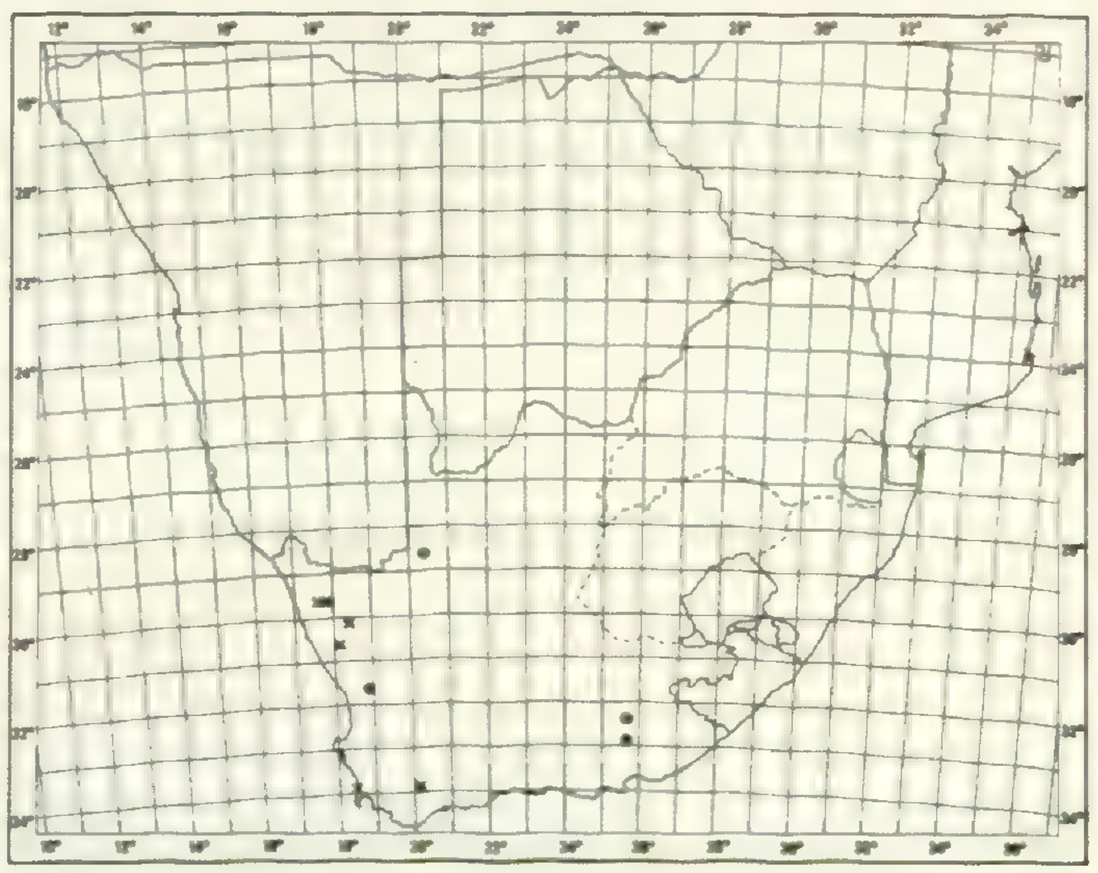
Originally described from the fynbos of the southeastern Cape Province; recent collections have been made in the dwarf succulent shrublands of the western and northern Cape. Map 78.

Vouchers: *Barnard* PRE-CH5760; *Booi* 126; *Magill & Schelpe* 3879, 3882, 3908.

These very small, bulbous plants are recognized by the broadly ovate to oval leaves, percurrent costa and long-exserted capsules. They could be confused with papillose forms of *P. splachnoides* when sterile, but the more differentiated costal anatomy and recurved margins help to distinguish the species.

3. **Pottia subplanomarginata** *Dix.* in Trans. R. Soc. S. Afr. 18: 253 (1930). Type: Cape, Stellenbosch, *Wager* 671 (BM, holo.!; PRE!).

Plants small, in loose cushions, yellowish to reddish green; terricolous. *Stems* 1–2 mm tall; in section round, central cells very thin-walled, cortical cells lax, yellowish. *Leaves* weakly contorted dry, spreading wet; oblong-lanceolate to oblong-elliptical, 1,2–1,5 mm long; apex acute, cuspidate; margins narrowly revolute to plane, entire. *Costa* short-excurrent, awn to 0,1 mm long, smooth; ventral superficial cells quadrate to short-rectangular, papillose, dorsal superficial cells rectangular, smooth; in section round, guide cells 2, ventral surface cells larger, thickened, papillose, dorsal stereid band small, 1–3 cells thick, dorsal surface cells rounded, thickened, smooth. *Upper laminal cells* hexagonal to rectangular, papillose, 4–6 C-shaped papillae over lumen; marginal cells narrower, quadrate to rectangular, papillose; basal cells large, rectangular, smooth.



MAP 78.— ● **Pottia macowaniana**
× **Pottia splachnoides**

Autoicous. *Seta* 2–4 mm long, yellowish; capsule ovoid to cylindrical, 0,8 mm long; exothecial cells rectangular, 2 rows at mouth quadrate; peristome very rudimentary to absent, consisting of 1–2 lightly papillose cells at mouth; operculum rostrate, deciduous; calyptra cucullate; spores angular, 25–32 μm, granulate. Fig. 58: 21–29.

Known only from Southern Africa, *P. subplanomarginata* is found in shrublands of the western and eastern Cape Province and South West Africa/ Namibia. Map 77.

Vouchers: *Magill & Schelpe* 3877a, 3884; *Wager* 7837.

The relatively long, oblong leaves and short-excurrent costa of *P. subplanomarginata* will separate it from the other Southern African species.

The description and illustration of *P. verrucosa* strongly suggest that the type (B) was *P. macowaniana*, however, the specimen at NH! is *P. subplanomarginata*.

4. Pottia splachnoides (*Hornsch.*) *Broth.* in Natürl. PflFam. 1: 423 (1902). Type: Cape, Kanker Bay, *Bergius* s.n. (G!).

Phascum splachnoides Hornsch. in Hor. Phys. Berol. 57 (1820).

Plants small, gregarious or in small groups, yellowish green; terricolous. *Stems* 1–2 mm high; in section round, central strand absent, cortical cells lax. *Leaves* weakly crisped dry, erect wet; oblong to lingulate, 0,8–1,8 mm long, weakly concave; apex acute; margins plane to erect, entire. *Costa* percurrent to subpercurrent; ventral superficial cells quadrate, smooth or papillose, dorsal superficial cells rectangular, smooth or papillose; in section round, guide cells small, generally undifferentiated, central cells small, incrassate, ventral and dorsal surface cells larger, thin-walled. *Laminal cells* turgid, subquadrate to short-rectangular, thin-walled, almost smooth or with 4–8 fine, C-shaped

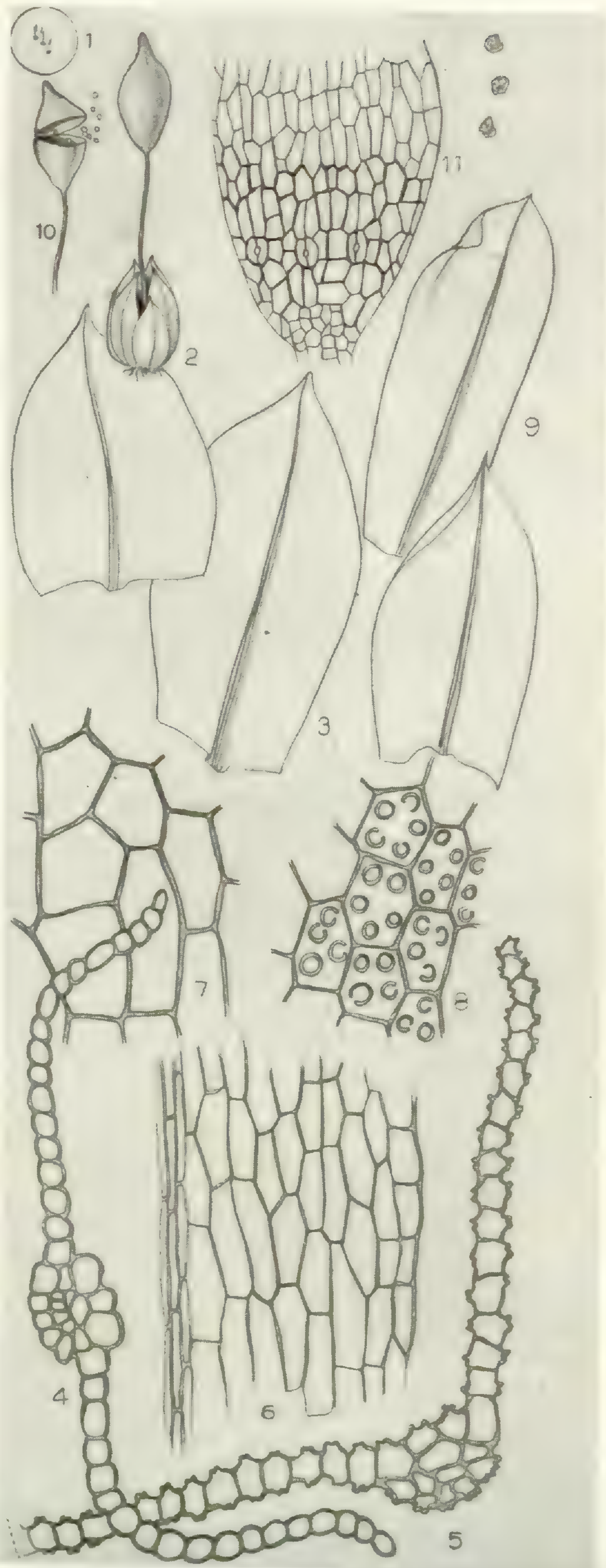


FIG. 59.—**Pottia splachnoides: 1.** habit, ×1; **2.** habit, ×20; **3.** leaves, ×50; **4.** leaf in cross section (smooth-celled form), ×435; **5.** leaf in cross section (papillose-celled form), ×435; **6.** basal leaf cells, ×170; **7.** upper laminal cells (smooth-celled form), ×640; **8.** upper laminal cells (papillose-celled form), ×640; **9.** perichaetial leaf, ×50; **10.** capsule showing line of dehiscence and spores, ×20; **11.** exothecial cells and stomata at capsule base with spores, ×90. (1–3 & 9–11, *Schelpe* 7728; 4 & 6–7, *Schelpe* 7716a; 5, *Schelpe* 7780; 8, *Goldblatt* 639).

papillae over lumen; marginal cells narrowly rectangular or quadrate; basal cells larger, rectangular, yellowish.

Autoicous. Antheridia in lower leaf axils; perichaetia terminal, leaves undifferentiated. *Seta* erect, 2–3 mm long, yellowish; capsule cleistocarpic, exserted, reddish yellow, ovate to cylindrical, 1,0–1,8 mm high, long-rostrate, 0,3 mm long, weakly oblique; exothecial cells narrowly rectangular or some cells quadrate or triangular, urn dividing at middle when mature along weakly defined dehiscence line; stomata at base of urn, phaneropore; calyptra large, cucullate, long-rostrate, to 1,3 mm long, covering upper ½ of capsule, becoming oblique with age; spores subround to angular, 32–37 μm, verruculate. Fig. 59: 1–11.

Endemic to Southern Africa, this species is restricted to the shrublands of the western Cape Province. Map 78.

Vouchers: *Goldblatt* 639; *Schelpe* 7716a, 7728, 7780; *Tölken* 1586a.

Pottia splachnoides is regarded as a highly variable species encompassing a variety of leaf shapes and a large variation in the degree of leaf cell papillosity, and the size and shape of capsules. In view of similar variability shown by the Australian species *P. drummondii* (Wils.) Willis (Scott & Stone, 1976) it is probable that the cleistocarpic species of *Pottia* present in Australia [*P. drummondii*], New Zealand [*P. maritima* (R. Br. ter.) Broth.] and Southern Africa [*P. splachnoides*] represent a single, widespread, Southern Hemisphere taxon. The specimens recorded from South Africa by Schelpe (1969) as *P. maritima* are included here.

7. DESMATODON

Desmatodon *Brid.*, Mant. Musc. 86 (1819); Grout, Moss Fl. N. Amer. 1: 222 (1939); Saito in Bull. nat. Sci. Mus., Tokyo 16: 66 (1973). Lectotype species: *D. latifolius* (Hedw.) Brid., vide Venturi, Comment. Fauna Fl. Veneto Trentino 1: 123 (1868).

Plants small, gregarious or loosely caespitose; terricolous or saxicolous. *Stems* 2–5 mm tall, sparingly branched; with central strand. *Leaves* oval to lingulate; apex acute to obtuse; margins plane to revolute, sometimes bordered, entire. *Costa* mucronate or percurrent, strongly convex ventrally; in section guide cells 2–6, ventral cells large, surface cells slightly larger than laminal cells, dorsal stereid band small. *Laminal cells* quadrate to hexagonal, with numerous C-shaped papillae over lumen; marginal cells generally less papillose, sometimes differentiated.

Autoicous or dioicous. Perichaetia terminal, leaves somewhat larger or undifferentiated. *Seta* long, erect; capsule cylindrical, infrequently ovoid; peristome teeth divided into 2 long, papillose filaments, fragile, frequently broken; operculum conical; calyptra cucullate; spores round to reniform, smooth to punctate.

Desmatodon, a genus comprising 33 species, is best represented in temperate regions of the Northern Hemisphere. *Desmatodon convolutus* is, however, found in semi-arid to temperate regions throughout the world. In Southern Africa the genus is common in semi-arid shrublands of the Cape and South West Africa/Namibia, but is also occasionally collected in grasslands of Natal and the Orange Free State.

1 Leaf margins revolute, marginal cells frequently smooth or almost so, not differentiated. . . . 1. *D. convolutus*
1 Leaf margins plane, most leaves bordered by 3–5 rows of smooth, incrassate cells. . . . 2. *D. longipedunculatus*

1. **Desmatodon convolutus** (*Brid.*) *Grout*, Moss Fl. N. Amer. 1: 224 (1939); Flowers, Moss. Utah 194 (1973). Type: Switzerland.

Trichostomum convolutum Brid., Muscol. Recent. Suppl. 1: 232 (1806).

Grimmia atrovirens J.E. Sm., Engl. Bot. 28: 2015 (1809). *Tortula atrovirens* (J.E. Sm.) Lindb. in Öfvers. K. VetenskAkad. Förh. 21: 236 (1864); Sim, Bryo. S. Afr. 233 (1926).

Tortula recurvata Hook., Musci Exot. 2: 130 (1819); Dix. in Trans. R. Soc. S. Afr. 8: 194 (1920). *Barbula recurvata* (Hook.) Schultz in Nova Acta Acad. Leop. Carol. 11: 216 (1823). *Desmatodon recurvatus* (Hook.) Mitt. in F. Müll., Fragm. Phyt. Aust. Suppl. 11: 114 (1881); Catcheside, Moss. South Austr. 148 (1980). Type: Cape, near Roggeveld, *Burchell* s.n. (BM, holo.!).

Tortula parvula Hook. & Grev. in Edinb. J. Sci. 1: 302 (1824). *Barbula parvula* (Hook. & Grev.)

Spreng., Syst. Veg. 4: 179 (1827). Type: Cape of Good Hope, *Menzies* s.n., 1791.

Didymodon capensis Spreng., Syst. Veg. 4: 179 (1827); C. Müll. in Linnaea 17: 598 (1843). Type: Cape, Van Kamps Bay, *Ecklon* s.n., 1825.

Barbula circinalis C. Müll. in Linnaea 18: 703 (1845). Type: Cape, Swellendam, *Ecklon* s.n.

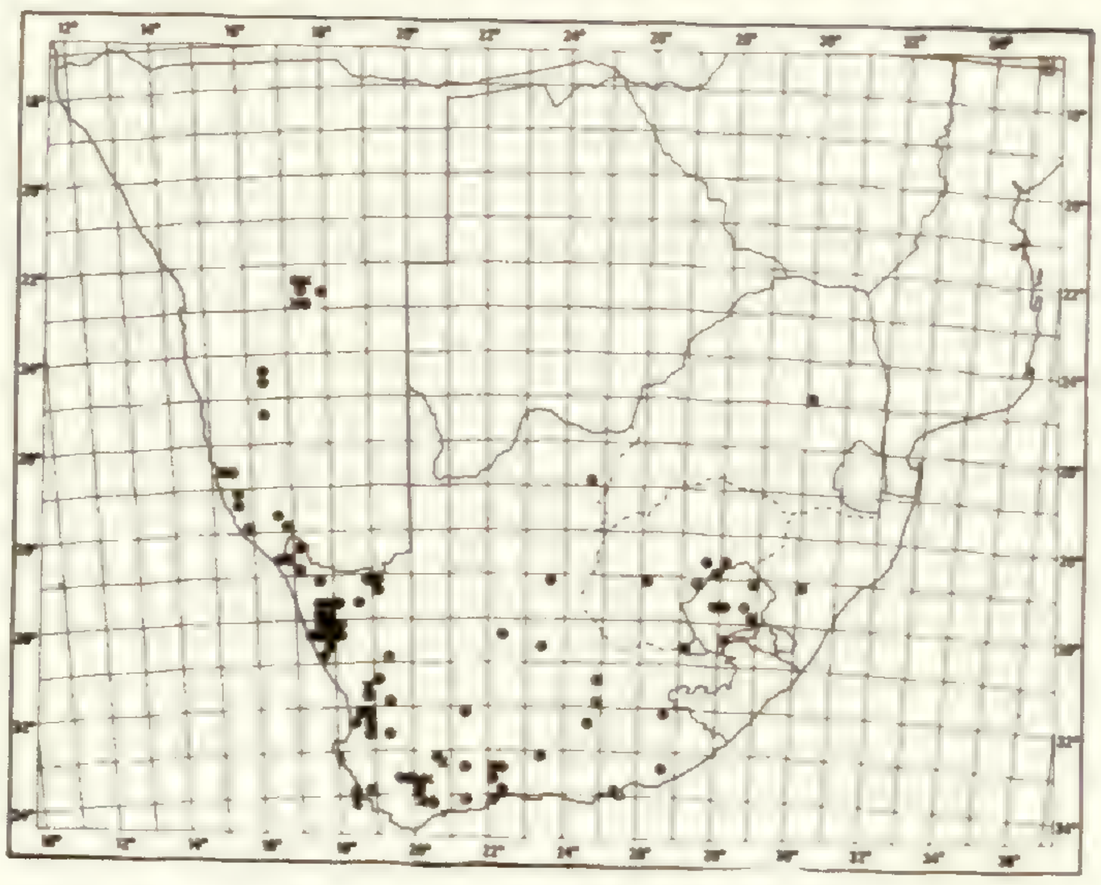
Tortula subtorquatifolia Dix. in K. norske Vidensk. Selsk. Skr. 1932, 4: 8 (1932). Type: Cape, Vryburg, *Hφeg* 1 (BM, holo.!).

Plants small, gregarious or in loose patches, dark green to blackish dry, green to light green wet; terricolous or saxicolous. *Stems* short, 2–5 mm high, sparingly branched; in section with central strand, inner cortical cells lax, outer cortical cells in 1–3 rows, smaller, reddish. *Leaves* incurled, spirally twisted or contorted dry, wide-spreading wet; shape extremely variable, oval to oblong on short-leaved plants or oblong to lingulate on long-leaved plants; apex acute to obtuse; margins narrowly revolute, entire. *Costa* percurrent, strongly convex ventrally in upper leaf; ventral superficial cells quadrate, papillose, dorsal superficial cells elongate, strongly incrassate, smooth; in section oval, guide cells 4–6, ventral cells in 1–2 layers, surface cells enlarged, frequently vertically elongated, papillose, dorsal stereid band 4–6 cells thick, dorsal surface cells substereids. *Upper laminal cells* quadrate to hexagonal, with 4–6 C-shaped papillae over lumen; cells of revolute margins smooth or nearly so, rarely all laminal cells only weakly papillose; basal cells rectangular, lax, smooth.

Autoicous. Perichaetia terminal, leaves undifferentiated. *Seta* 6–15 mm long, yellow to reddish; capsule ovoid to cylindrical, 1,0–2,5 mm long, reddish brown; peristome teeth divided into 2 papillose filaments above short basal membrane, 0,3–0,5 mm high, yellowish, frequently irregular, broken; operculum conical to obliquely rostrate, 1 mm long; spores roundish, 17–25 μm, finely punctate. Fig. 60: 1–10.

Desmatodon convolutus is found in Europe, the Middle East, Africa, Micronesia, Australia, New Zealand, North America and southern South America. In Southern Africa, the species is common in arid and semi-arid shrublands throughout the Cape Province. It is also frequently collected in the Orange Free State, Lesotho and southern South West Africa/Namibia, and occasionally in the Transvaal and Natal. Map 79.

Vouchers: *Emdon* 203a; *Lavranos* 15470; *MacDonald* 77/84; *Magill* 4177, 5846; *Schelpe* 7783, 7821; *Smook & Harding* 799; *Volk* 6642.



MAP 79.— ● Desmatodon convolutus
× Desmatodon longipedunculatus

Sometimes troublesome in its many forms, *D. convolutus* can generally be recognized by the enlarged, upper ventral costal cells. Some of the smaller plants with rounded leaves may be confused with *Pottia*. These smaller forms may also occasionally have rudimentary peristomes that make identification even more difficult. The presence of a central strand in the stem and the more highly developed costal anatomy, will separate *Desmatodon* from *Pottia*.

2. **Desmatodon longipedunculatus** (*C. Müll.*) *Magill*, comb. nov. Type: Cape, Swellendam, *Pappe* s.n., 1838 (H, iso.!).

Barbula longipedunculata C. Müll., Syn. Musc. 1: 630 (1849). *Tortula longipedunculata* (C. Müll.) Broth. in Natürl. PflFam. 1: 432 (1902); Sim, Bryo. S. Afr. 230 (1926).

Barbula deserta C. Müll. in Hedwigia 38: 108 (1899). *Tortula deserta* (C. Müll.) Broth. in Natürl. PflFam. 1: 430 (1902). Type: Cape, Cape Town, *Rehmann* ?96, 1875.

Plants small, caespitose, greyish green to blackish green dry, yellowish green wet, reddish brown below; terricolous. *Stems* 2–4 mm tall, unbranched; in section with large central strand, cortical cells lax, single outer row of cells smaller, incrassate, red-brown. *Leaves* appressed, spirally twisted dry, patent wet; oval to lingulate, 1,0–2,6 mm long; apex obtuse; margins plane, entire, marginal cells differentiated, forming unistratose border 3–5 cells wide. *Costa* mucronate; ventral superficial cells quadrate, papillose, dorsal superficial cells rectangular, thickened, with scattered, low, blunt papillae; in section with 2–4 guide cells, ventral cells in 1–2 rows,

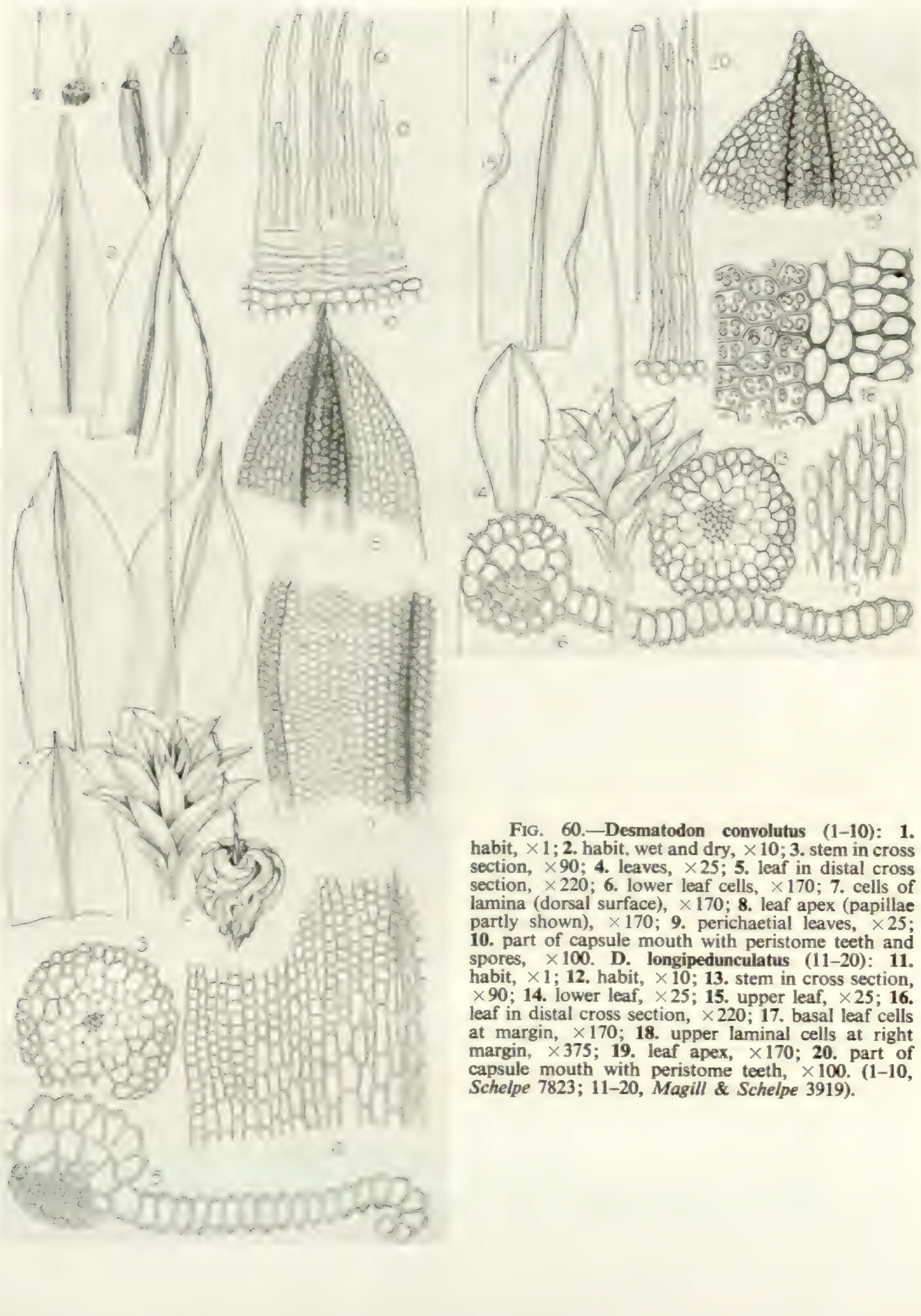


FIG. 60.—**Desmatodon convolutus** (1–10): **1.** habit, ×1; **2.** habit, wet and dry, ×10; **3.** stem in cross section, ×90; **4.** leaves, ×25; **5.** leaf in distal cross section, ×220; **6.** lower leaf cells, ×170; **7.** cells of lamina (dorsal surface), ×170; **8.** leaf apex (papillae partly shown), ×170; **9.** perichaetial leaves, ×25; **10.** part of capsule mouth with peristome teeth and spores, ×100. **D. longipedunculatus** (11–20): **11.** habit, ×1; **12.** habit, ×10; **13.** stem in cross section, ×90; **14.** lower leaf, ×25; **15.** upper leaf, ×25; **16.** leaf in distal cross section, ×220; **17.** basal leaf cells at margin, ×170; **18.** upper laminal cells at right margin, ×375; **19.** leaf apex, ×170; **20.** part of capsule mouth with peristome teeth, ×100. (1–10, *Schelpe* 7823; 11–20, *Magill & Schelpe* 3919).

large, surface cells papillose, dorsal stereid band 4–5 cells thick, dorsal surface cells substereids, 1–2 lateral surface cells similar to ventral surface cells. *Upper laminal cells* quadrate to hexagonal, some transversely rectangular, with 4–5 low, C-shaped papillae over lumen; marginal cells quadrate to rectangular, some transversely rectangular, incrassate, smooth to weakly papillose, generally forming distinct border above base; basal cells quadrate to rectangular, smooth, smaller toward margin.

Dioicous. Perichaetia terminal, leaves undifferentiated. *Seta* 10–12 mm long, yellow to red; capsule erect, cylindrical, 2,0–2,5 mm long, red-brown; peristome teeth divided to base into 2 long papillose filaments, 0,8 mm long, spirally twisted one turn; operculum conical, 1,0 mm long; spores round, to reniform, 10–12 μm, smooth. Fig. 60: 11–20.

Originally described from the fynbos biome of the southwestern Cape, *D. longipedunculatus* is also found in the dwarf succulent shrublands of the northwestern Cape and the Khomas Highland Savanna of South West Africa/Namibia. The species was recently reported from Kenya by Bizot, Pócs & Sharp (1979). Map 79.

Vouchers: *Magill & Schelpe* 3884a; *Tölken* 5684; *Volk* 00950.

Although not always pronounced, the plane, bordered leaf margins will separate this species from *D. convolutus*. In section the cells along the leaf margins are slightly larger, incrassate, and nearly smooth. This weak border is generally obvious in surface view, but occasionally the cells are papillose and the border is only detectable in cross section.

8. TORTULA

Tortula *Hedw.*, Sp. Musc. 122 (1801), nom. cons.; Broth. in Natürl. PflFam. 10: 295 (1924); Steere in Grout, Moss Fl. N. Amer. 1: 228 (1939); Sim, p.p., Bryo. S. Afr. 224 (1926). Type species: *T. subulata* Hedw.

Plants small to large, forming large tufts, dark green to yellowish or brownish green: corticolous, saxicolous or terricolous. *Stems* frequently branched; generally with central strand. *Leaves* appressed, twisted or contorted dry, widespreading wet; piliferous, triangular to spathulate; apex acute to emarginate; margins plane to revolute. *Costa* mucronate to long-excurrent, smooth to denticulate, reddish yellow to hyaline; in section without ventral stereid band, dorsal stereid band large, prominent. *Laminal cells* quadrate to polygonal, with numerous C- or O-shaped papillae, rarely with single spinose papilla per cell; basal cells generally larger, quadrate to rectangular, smooth, hyaline. *Propagulae* leaf-like, produced in stem apex; gemmae round, multicellular, produced on upper ventral costal surface or on stem tomentum.

Autoicous, synoicous or dioicous. Perichaetial leaves undifferentiated. Capsule long-exserted, cylindrical; peristome teeth divided into 32 filaments above basal membrane, spirally twisted, papillose; operculum conical; calyptra cucullate; spores round, finely granular, punctate or smooth.

Tortula, with 250 species, is found throughout the world in a great variety of habitats. In Southern Africa the genus is frequently collected in the Cape and Natal; however, specimens are found throughout the Flora area.

1 Costa mucronate:
  2 Leaves fragile, especially below; sterile plants without propagulae; capsule mouth with several rows of smaller cells ..... 3. *T. schmidii*
  2 Leaves not fragile; leaf-like propagulae produced on short stalks at apex or in leaf axils; capsule mouth with 2–3 rows of smaller cells ..... 4. *T. ammonsiana*
1 Costa apiculate to long-excurrent:
  3 Costa apiculate to short-excurrent:
    4 Leaves ovate-acuminate to triangular; margins spirally revolute; marginal cells enlarged; gemmae not known ..... 1. *T. porphyreoneura*
    4 Leaves broadly spathulate; margins plane; marginal cells undifferentiated; gemmae produced on ventral costal surface ..... 6. *T. papillosa*

3 Costa long-excurrent:
5 Awn smooth or almost so:
6 Plants corticolous; leaf margins plane; propagulae produced at stem apex..... 5. *T. pagorum*
6 Plants terricolous; leaf margins revolute; without propagulae..... 2. *T. muralis*
5 Awn denticulate:
7 Plants synoicous; leaves widespreading when wet; awn weakly denticulate; apex obtusely acute to retuse; stem with small central strand..... 7. *T. princeps*
7 Plants dioicous; leaves recurved to squarrose; awn roughly denticulate; apex emarginate; stem without central strand..... 8. *T. ruralis*

1. **Tortula porphyreoneura** (*C. Müll.*) *Townsend* in J. Bryol. 10: 576 (1979). Type: Ethiopia, Abita Keren, *Beccari* s.n., 1870 (FI).

Barbula porphyreoneura C. Müll. ex Vent. in Nuovo G. bot. ital. 4: 13 (1872).

Tortula torquatifolia (Geh.) Dix. in K. norske Vidensk. Selsk. Skr. 1932 (4): 8 (1932); Hilpert in Beih. bot. Zbl. 50: 626 (1933); fide Townsend in J. Bryol. 10: 576 (1979). *Barbula torquatifolia* Geh. in Bull. Herb. Boissier 4: 410 (1896); Broth. in Natürl. PflFam. 1: 411 (1902); 10: 280 (1924); Sim, Bryo. S. Afr. 235 (1926). Type: South West Africa/Namibia, Oshando, *H. Schinz* s.n., 1886 (G, holo.!; Z).

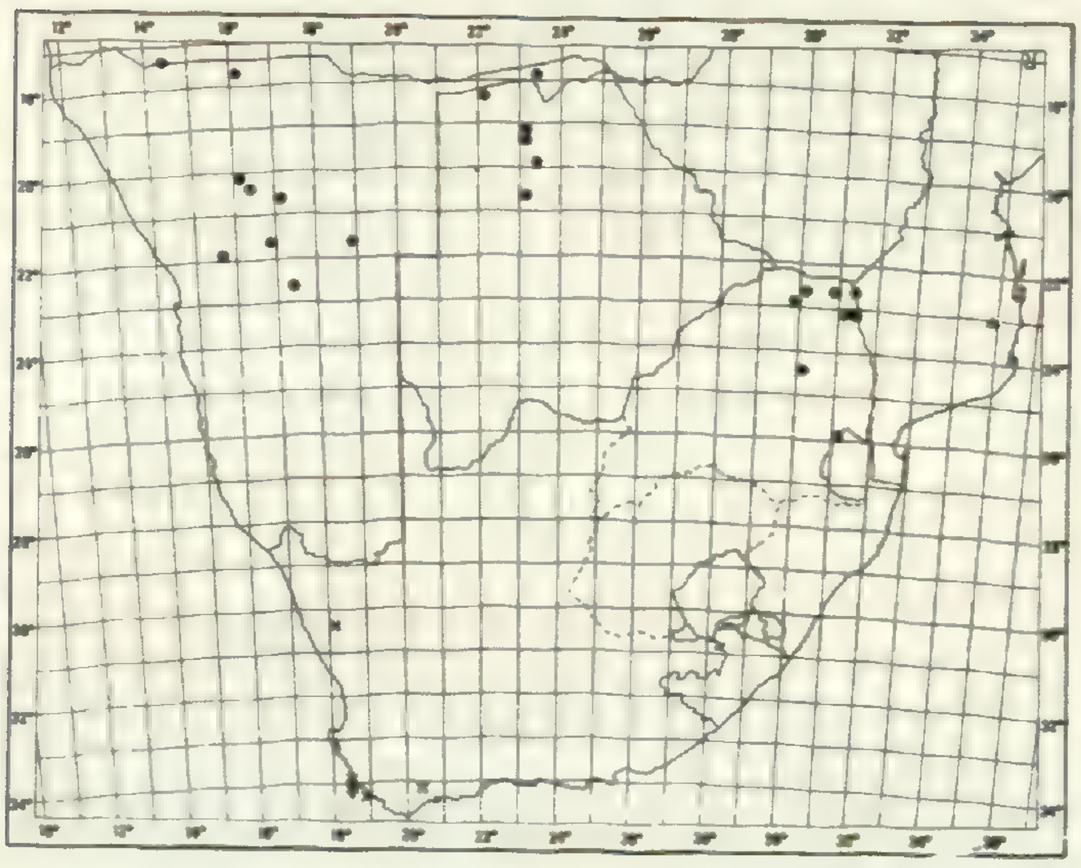
Plants small, in loose tufts, green; terricolous. *Stems* 5–10 mm tall, lower parts frequently buried, unbranched; in section with central strand, inner cortical cells large, lax, outer cortical cells in 1–3 rows, smaller, incrassate, red-brown. *Leaves* imbricate, contorted or spirally twisted dry, spreading wet; ovate-acuminate to triangular, 1,5–2,5 mm long; apex acute to obtuse; margins spirally revolute, entire; marginal cells differentiated into specialized photosynthetic region; in section 4–5 cells enclosed by spiralling leaf, enlarged, thin-walled. *Costa* apiculate to short-excurrent as smooth, yellow awn, 35–40 μm wide at apex; ventral superficial cells quadrate, papillose, dorsal superficial cells rectangular, incrassate, smooth; in section guide cells 2, ventral cells 2, papillose, dorsal stereid band 5–8 cells thick, dorsal surface cells frequently substereids. *Upper laminal cells* quadrate to hexagonal, juxtacostally with 4–6 C- or O-shaped papillae over lumen, cells of revolute portion smooth or ventrally papillose; marginal cells enlarged, lax; basal cells quadrate, smooth.

Dioicous. Perichaetia terminal, leaves undifferentiated. *Seta* 5–7 mm long, yellowish red, becoming red with age; capsule cylindrical, 1,5–1,8 mm long, red-brown; peristome short, 0,6 mm high, teeth linear above short basal membrane, spirally twisted 1–2 times, papillose; operculum rostrate, 0,8 mm long; spores round, 10–11 μm, smooth or weakly punctate. Fig. 61: 1–9.

Tortula porphyreoneura is known from Arabia and eastern and Southern Africa. In the Flora area the species is infrequently collected around rock outcrops in grasslands in northern South West Africa/Namibia, Botswana, and the northern and eastern Transvaal. Map 80.

Vouchers: *Hardy* 5173; *Leistner et al.* 72; *Magill* 4761, 4954; *Tölken* 5559.

The macroscopic resemblance of this species to *Barbula* is superseded by the *Tortula*-like peristome and costal anatomy. The differentiated marginal leaf cells would place this species in *Pseudocrossidium* sensu Zander (1979); see note under *Barbula acutata*.



MAP 80.— ● **Tortula porphyreoneura**
× **Tortula princeps**

2. **Tortula muralis** *Hedw.*, Sp. Musc. 123 (1801); Broth. in Natürl. PflFam. 10: 297 (1924); Sim, Bryo. S. Afr. 230 (1926). Type: Europe.

Barbula chrysoblasta C. Müll. in Hedwigia 38: 104 (1899). Type: Cape, Uitenhage, *Breutel* s.n.

Barbula afroinermis C. Müll. in Hedwigia 38: 104 (1899). Type: Cape, Cape Town, *Naumann* s.n., 1874 (BM, iso.!).

Plants small, in dense tufts, yellow-green to dark green; terricolous. *Stems* 4–8(–12)

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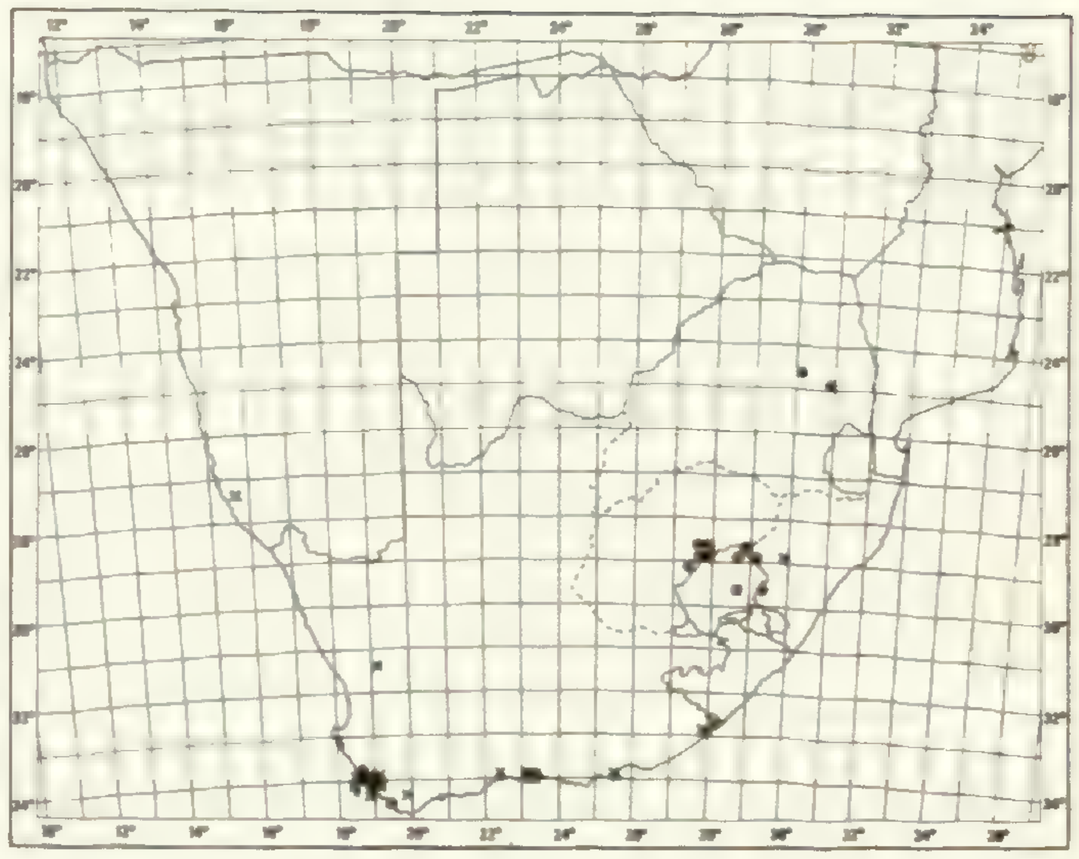
mm tall, branched below; in section with central strand, cortical cells larger toward margin, reddish. *Leaves* erect, contorted or spirally twisted dry, spreading wet; oblong-spathulate to lingulate, 2–3 mm long; apex obtuse, retuse or emarginate, often asymmetrical; margins revolute to apex, entire. *Costa* excurrent, 1–2 mm long, smooth, hyaline; ventral superficial cells quadrate to rectangular, thin-walled, papillose, dorsal superficial cells elongate-rectangular, incrassate, smooth; in section guide cells 2–4, ventral cells 4–8, in single or double row, surface cells papillose, dorsal stereid band 6–8 cells thick, dorsal surface cells undifferentiated, smooth. *Upper laminal cells* quadrate to hexagonal, densely papillose with 6–8 C-shaped papillae over lumen; basal cells rectangular, hyaline, smooth.

Autoicous. Perichaetial leaves undifferentiated. *Seta* 10–20 mm long, yellowish, becoming reddish to red-brown with age; capsule cylindrical, 2,5–3,0 mm long, red-brown, peristome 0,6 mm high, teeth linear, above short basal membrane, papillose, spirally twisted 1–2 times; operculum conical, 1 mm long; spores round, 9–12 μm, weakly papillose. Fig. 61: 17–23.

Tortula muralis is almost cosmopilitan in its distribution. In Southern Africa the species is frequently collected in the southwestern Cape, especially in and around Cape Town. A few specimens are also known from southern South West Africa/Namibia, the western, southern and eastern Cape and Natal. The species is commonly collected on old rock walls or other cement structures. Map 81.

Vouchers: *Cholnoky* 860a; *Ellis* 3102; *Esterhuysen* 18880; *Garside* 6569; *Magill* 6246, 6330; *Sim* 9312.

The plants are considerably smaller than the other species of *Tortula* in Southern Africa. The smooth, incrassate, ± rectangular cells at the leaf apex, useful for identification in other regions, are not always present in the Southern African plants. This appears however, to be the only difference between Southern and Northern Hemisphere plants. The presence of *T. muralis*, primarily on man-made structures, indicates its introduction by man.



MAP 81.— ● **Tortula ammonsiana**
× **Tortula muralis**

3. **Tortula schmidii** (*C. Müll.*) *Broth.* in Natürl. PflFam. 1: 434 (1902); Townsend in J. Bryol. 10: 129 (1978). Type: India.

Barbula schmidii C. Müll. in Bot. Ztg 11: 58 (1853). *Barbula erubescens* C. Müll. in Nuovo G. bot. ital. 4: 14 (1872). *Tortula erubescens* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902), hom. illeg.; Sim, Bryo. S. Afr. 227 (1926). Type: Ethiopia, Bogos, Keren, *Beccari* s.n. (FI).

Barbula hildebrandtii C. Müll. in Linnaea 40: 294 (1876). *Tortula hildebrandtii* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902). Type: Somalia, *Hildebrandt* sub 1502.

Barbula brachyaichme C. Müll. in Hedwigia 38: 102 (1899). *Tortula brachyaichme* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902). Type: Cape, Cape Town, *Rehmann* s.n. (BM!).

Barbula exesa C. Müll. in Hedwigia 38: 103 (1899). *Tortula exesa* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1883.

Barbula macowaniana C. Müll. in Hedwigia 38: 103 (1899). *Tortula macowaniana* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902). Type: Cape, Somerset East, *MacOwan* s.n., 1878 (GRA!).

Barbula oranica C. Müll. in Hedwigia 38: 103 (1899). *Tortula oranica* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902). Type: Orange Free State, Bethlehem, *Rehmann* 126 (PRE!).

FIG. 61.—**Tortula porphyreoneura** (1–9): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×100; **4.** leaves, ×35; **5.** leaf in cross section, ×280; **6.** basal leaf cells, ×170; **7.** upper laminal cells, ×640; **8.** leaf apex, ×170; **9.** part of capsule mouth with peristome teeth and spores, ×75. **T. schmidii** (10–16): **10.** habit, ×1; **11.** habit, ×10; **12.** stem in cross section, ×100; **13.** leaves, ×20; **14.** leaf in cross section, ×175; **15.** upper laminal cells, ×425; **16.** parts of capsule mouth and peristome, ×75. **T. muralis** (17–23): **17.** habit, ×1; **18.** habit, ×10; **19.** leaves, ×20; **20.** leaf in cross section, ×175: **21.** upper laminal cells, ×480; **22.** cells at leaf apex (left side), ×170; **23.** deoperculate capsule, ×10; **24.** capsule mouth and peristome, ×100. (1–9, *Leistner et al.* 72; 10–15, *Sim* 8669; 16–18, *Magill* 6246; 19–24, *Sim* 9202).

Barbula brevimucronata C. Müll. in Hedwigia 38: 104 (1899). *Tortula brevimucronata* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902). Type: Transvaal, Spitzkop, near Lydenburg, *Wilms* s.n., 1888 (G, holo.!).

Tortula brevitubulosa Broth. in Denkschr. Akad. Wiss., Wien. Math.-nat. Kl. 88: 736 (1913). Type: Natal, Van Reenens Pass, Schwarzerberg, *Brunthaler* s.n., 4/12/1909 (H-BR, holo.!).

Tortula irregularis Sim, Bryo. S. Afr. 231 (1926). Type: Natal, Edendale Falls, *Sim* 10064 (PRE, holo.!).

Plants medium-sized, forming dense tufts, dark green to olive-green; corticolous, less frequently saxicolous or terricolous. *Stems* 10–15 mm high, occasionally branched, tomentose below; in section with small central strand, inner cortical cells large, thin-walled, outer cortical cells in 3–4 rows, smaller, incrassate, yellow-red. *Leaves* appressed, contorted dry, widespreading to recurved wet, fragile, lamina frequently broken or absent in lower stem; lingulate to spathulate, 2,5–3,0 mm long; apex obtuse; margins recurved below, plane above, irregularly and weakly lobed in upper leaf. *Costa* mucronate to apiculate; ventral superficial cells quadrate, thin-walled, papillose, dorsal superficial cells elongate, strongly incrassate, denticulate above; in section with 2–4 large guide cells, ventral cells incrassate, in 2 layers, ventral surface cells papillose, dorsal stereid band large, 6–8 cells thick, dorsal surface cells not differentiated. *Upper laminal cells* quadrate to hexagonal, with 4–6 C-shaped papillae over lumen; basal cells rectangular to quadrate, smooth; upper basal marginal cells quadrate.

Sporophytes not known in Southern Africa. Fig. 61: 10–16.

Known from India and eastern Africa south to the Cape, the species is common in forest and woodland. Within the Flora area, *T. schmidii* is most frequently collected on trees in the forests of the eastern Transvaal, Swaziland, Natal, Transkei and the eastern and southwestern Cape, or on soil in the western Cape and rocks in the high grasslands of Lesotho and at Mont-aux-Sources in the Orange Free State. Map 82.

Vouchers: *Crosby & Crosby* 8160; *Ellis* 3095; *Magill* 4613a, 4854, 5670; *Schelpe* 7549; *Smook* 1104.

The plants are identified by the fragile leaves with lamina frequently completely broken away on the lower stem leaves. The species is similar to *T. ammonsiana*, but that species produces abundant stalked propagulae, has non-fragile leaves and only 2–3 rows of smaller cells at the capsule mouth. The eastern African capsules of *T. schmidii* have 5–6 rows of smaller cells at capsule mouth (cf. Townsend, 1978).

4. **Tortula ammonsiana** *Crum & Anderson* in Bryologist 82: 469 (1979). Type: North America, West Virginia, *Anderson* 21897 (DUKE, holo.; MICH; TENN; WVA).

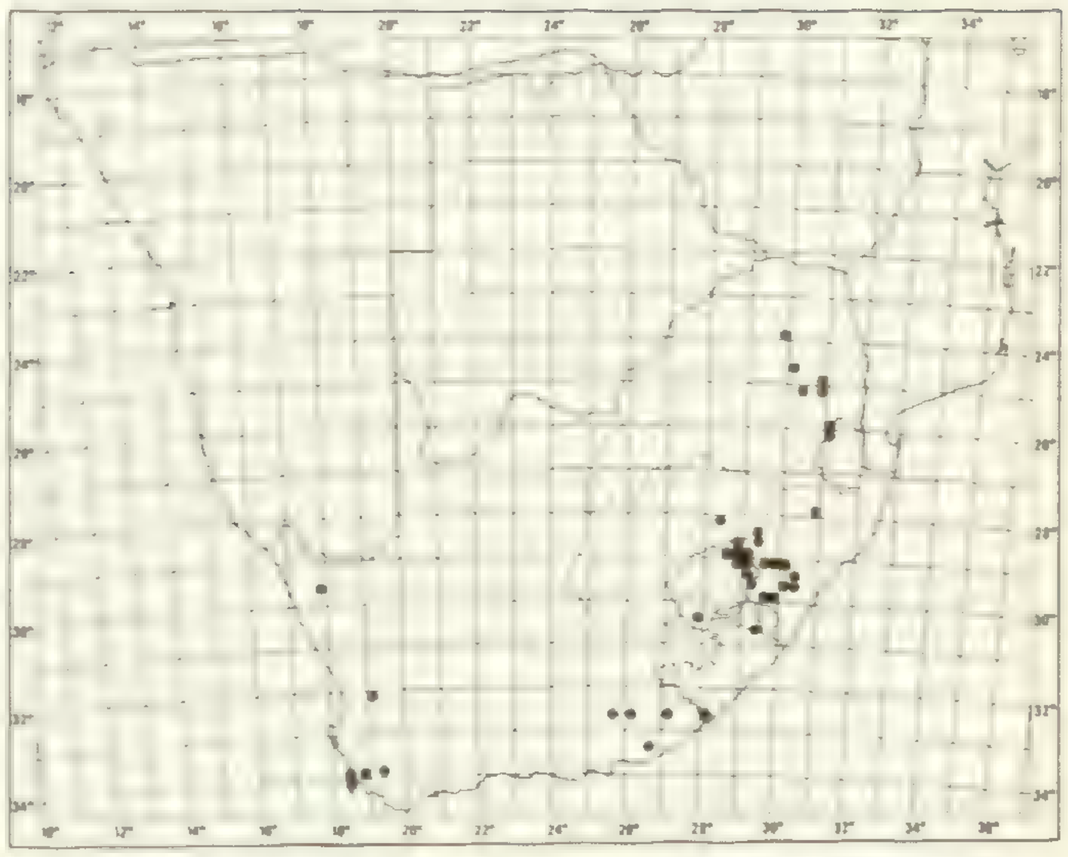
Plants medium-sized, forming loose tufts, green to dark green above, light brown below; saxicolous or corticolous. *Stems* 10–15 mm high, branching; in section with large central strand, inner cortical cells large, thin-walled, outer cortical cells in 1–2 rows, small, incrassate, reddish. *Leaves* imbricate, contorted dry, widespreading wet; lingulate to subspathulate, 2,5–4,5 mm long; apex rounded, margins entire, plane or reflexed at mid-leaf. *Costa* mucronate; ventral superficial cells quadrate or infrequently rectangular, thin-walled, papillose, dorsal superficial cells elongate, strongly incrassate, smooth; in section guide cells 2, ventral cells in two layers, surface cells papillose, dorsal stereid band 6–8 cells thick, dorsal surface cells not differentiated. *Upper laminal cells* quadrate to hexagonal, with 4–6 C-shaped papillae over lumen; basal cells rectangular, hyaline, smooth; upper basal marginal cells quadrate. *Propagulae* leaf-like, in clusters on short stalks at apex; elliptical; costa present, ending as smooth, yellow apiculate cell; body cells hexagonal, papillose.

Perichaetia terminal, leaves slightly smaller. *Seta* erect, 7–9 mm long, reddish yellow; capsule cylindrical, 2,0–2,5 mm long, reddish yellow, exothecial cells rectangular, 1–3 rows at mouth smaller, quadrate; peristome fragile, yellowish to reddish yellow, teeth weakly twisted, filamentous, ornately papillose above short, erectly tasselated basal membrane; mature operculum not seen, calyptra cucullate, 4 mm long; spores round, 15 μm, papillose. Fig. 62: 1–11.

This species was very recently described from the eastern United States. In Southern Africa the species is found in forests or grasslands of the eastern Transvaal, Orange Free State, Lesotho, Natal and southern and southwestern Cape. Map 81.

Vouchers: *Magill* 4595, 4860, 6268; *Van Rooy* 404, 572.

This species is recognized by its mucronate leaves and the production of numerous, stalked, leaf-like propagulae. The Southern African specimens differ from the North American plants in the absence of the minute apical teeth only. The species is related to *T. schmidii* and *T. pagorum*; differences are discussed under those species.



MAP 82.— ● **Tortula schmidii**

5. **Tortula pagorum** (*Milde*) *De Not.* in Atti Univ. Genova 1: 542 (1869); Broth. in Natürl. PflFam. 10: 300 (1924); Steere in Grout, Moss Fl. N. Amer. 1: 239 (1939). Type: Switzerland, *Milde* s.n.

Barbula pagorum Mild. in Bot. Ztg 20: 469 (1862).

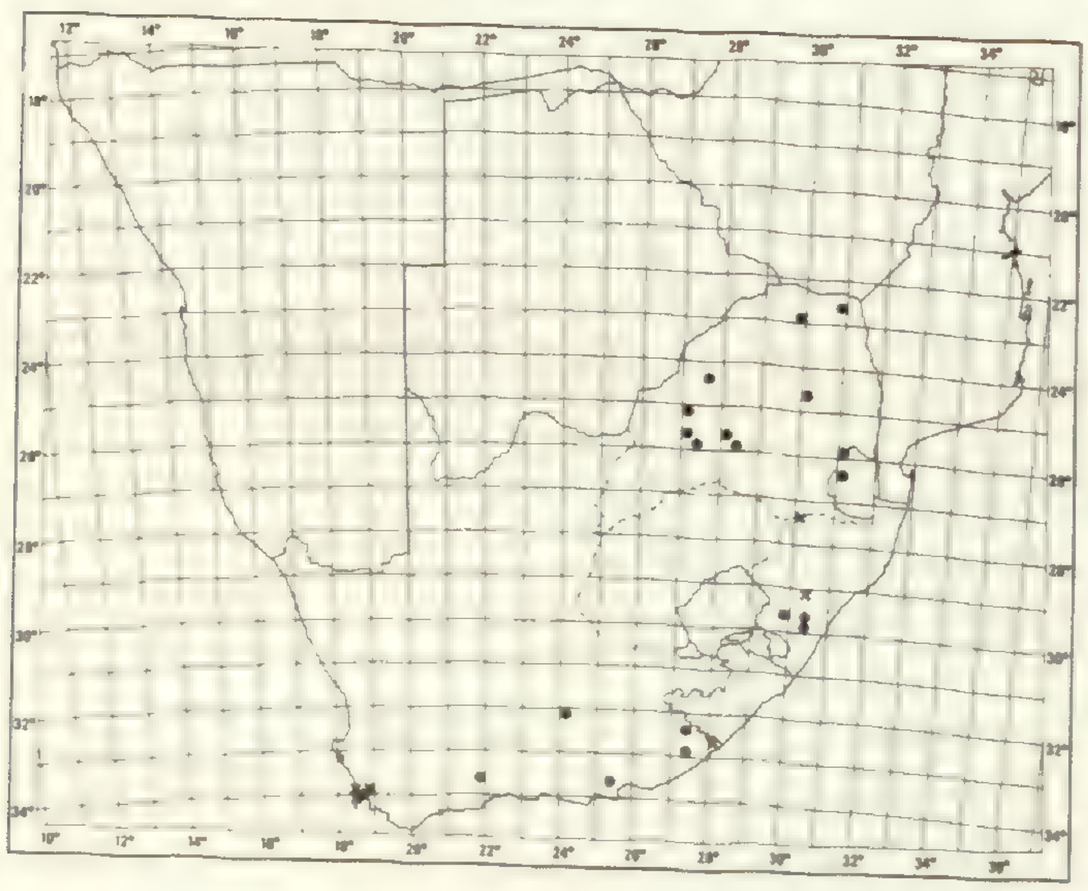
Plants small, in loose tufts, dark to olive-green; corticolous. *Stems* 2–4 mm high, unbranched; in section central strand present, inner cortical cells large, thin-walled, outer cortical cells in 1–2 rows, smaller, red-brown. *Leaves* appressed, incurved dry, widely spreading wet, comose; spathulate to broadly lingulate, 2 mm long; apex emarginate to retuse; margins plane, entire. *Costa* excurrent as long, smooth, hyaline awn; ventral superficial cells quadrate, thin-walled, papillose, dorsal superficial cells linear, strongly incrassate, smooth; in section with 2 guide cells, ventral cells in one layer, thin-walled, papillose, dorsal stereid band large, 7–8 cells thick. *Laminal cells* quadrate to hexagonal, with 4–8 C-shaped papillae over lumen; basal cells larger, quadrate to shortly rectangular,

FIG. 62.—**Tortula ammonsiana: 1.** habit, plant with apical propagulae, ×1; **2.** habit, plant with sporophyte, ×1; **3.** habit, plant with apical propagulae, ×10; **4.** stem in cross section, ×80; **5.** leaves, ×25; **6.** leaf in cross section, ×170; **7.** basal leaf cells at left margin, ×170; **8.** upper laminal cells (papillae partly shown), ×435; **9.** leaf apex (papillae partly shown), ×170; **10.** propagulum, ×140; **11.** capsule mouth with peristome, ×80. (1–11, *Crosby & Crosby* 8160).

smooth. *Propagulae* leaf-like, in large numbers at stem apex; elliptical; ecostate; apical cell elongate, pellucid, body cells hexagonal to subhexagonal, papillose, chlorophyllous.

Sporophyte not known in Africa, but described from Australia (Stone, 1971) as: Perichaetial leaves little differentiated. *Seta* 5–9 mm long, yellow above, reddish below; capsule short-cylindrical 2,0–2,4 mm long, slightly curved, brownish; peristome to 1,0 mm high, teeth linear, papillose, twisted once counter-clockwise, above a short basal membrane, 0,3 mm high; operculum narrowly conical, 1,5–1,7 mm long; calyptra cucullate, 2,5–3,0 mm long; spores 8–10 μm, slightly papillose, greenish brown. Fig. 63: 1–8.

Tortula pagorum is known from the Americas, Europe, Asia, Africa and Australia, generally in association with human habitation. In Southern Africa the species has been infrequently collected in the northern, central and eastern Transvaal, Swaziland, southern Natal and the eastern, central, southern and southwestern Cape. The species is most commonly found on bark of small trees or shrubs, in dry woodland communities. Map 83.



MAP 83.— ● **Tortula pagorum**
× **Tortula papillosa**

Vouchers: *Magill* 3198, 3514, 4921a, 6142; *Sim* 10083; *Smook* 990.

Tortula pagorum is recognized by its long-excurrent costa and the production of numerous propagulae at the stem apex. The species is related to *T. ammonsiana*, the only other Southern African species of *Tortula* that produces propagulae, but differs in the excurrent leaf costa and absence of costae in the propagulae that are sessile at the apex.

6. **Tortula papillosa** *Wils. ex Spruce* in J Bot., Lond. 4: 193 (1845); Broth. in Natürl. PflFam. 10: 300 (1924); Sim, Bryo. S. Afr. 226 (1926). Type: England.

Barbula reticularia C. Müll. in Hedwigia 38: 101 (1899). *Tortula reticularia* (C. Müll.) Broth. in Natürl. PflFam. 1: 434 (1902). Type: Cape, Cape Town, *Rehmann* 106 (PRE!).

Plants small, gregarious or in small tufts, green to brown-green; corticolous. *Stems* 2–8 mm high, infrequently branched; in section with central strand, cortical cells large, becoming smaller toward margin, yellow-brown. *Leaves* imbricate with incurved apices dry, widespreading wet; broadly spathulate, 2,0–2,5 mm long; apex obtusely acute to rounded; margins plane, entire. *Costa* spinose dorsally, gemmiferous ventrally, excurrent as short, yellowish, weakly toothed awn; ventral superficial cells producing numerous gemmae, dorsal superficial cells elongate, incrassate, sparsely papillose; in section with 2 guide cells, ventral cells 4, in single row, thin-walled, producing gemmae, dorsal stereid band 3–6 cells thick. *Laminal cells* hexagonal to polygonal, 20–25 μm, smooth ventrally, dorsally with 1(–2) C- or O-shaped, spinose papillae over lumen; basal cells rectangular, smooth. *Gemmae* round, multicellular, 50–80 μm, green.

Sporophyte not known in Southern Africa. Sporophytes from Australia, illustrated by Scott & Stone (1976), show differentiated perichaetial leaves that sheath the seta. The capsule is similar to that of *T. pagorum*, but the seta is shorter and twisted to the right. Fig. 63: 9–16.

Tortula papillosa is known from Europe and North America, southern South America, South Africa, Australia and New Zealand. The species is rare in Southern Africa. It is collected on bark of trees in dry woodlands and forests of Natal, and the eastern and southwestern Cape. Map 83.

Vouchers: *Ellis* 3092; *Sim* 9570, 10082.

This species is separated from the other Southern African species of *Tortula* by the single spinose papilla on the dorsal surface of leaf cells and in the production of multicellular gemmae on the upper ventral costal surface.

7. **Tortula princeps** *De Not.* in Memorie Accad. Sci. Torino 40: 288 (1838); Broth. in Natürl. PflFam. 1: 435 (1902); 10: 302 (1924); Grout, Moss Fl. N. Amer. 1: 244 (1939). Type: Sardinia, *Rabenhorst* s.n., 1847.

Barbula muelleri B.S.G., Bryol. Eur. 2: 106 (1842), nom. illeg. *Tortula muelleri* Hook. f. & Wils., Fl. Antarct. 1: 103 (1847), nom. illeg.; Sim, Bryo. S. Afr. 225 (1926).

Barbula leucostega C. Müll., Syn. Musc. 1: 641 (1847). *Tortula leucostega* (C. Müll.) Broth. in Natürl. PflFam. 1: 435 (1902). Type: Cape, Swellendam, *Ecklon* s.n., 1828.

Plants large, in dense tufts, green to yellow-brown; terricolous. *Stems* 10–30 mm high, branching, tomentose below; in section with central strand, cortical cells lax, becoming smaller toward margin, yellowish red. *Leaves* appressed, keeled, little contorted dry, erect to widespreading wet; broadly lingulate to spathulate, 3–4 mm long; apex obtusely acute to retuse; margins narrowly revolute below, plane above. *Costa* long-excurrent as hyaline awn, 1–2 mm long, weakly denticulate; ventral superficial cells quadrate, thin-walled, papillose, dorsal superficial cells elongate, strongly incrassate, smooth; in section guide cells 2, ventral cells in 1–2 layers, surface cells papillose, dorsal stereid band large, 4–5 cells thick, dorsal surface cells undifferentiated, smooth. *Laminal cells* quadrate to hexagonal, densely papillose, with 4–8 C- or O-shaped papillae over both surfaces; basal cells large, in well defined group, rectangular, hyaline, smooth.

Synoicous. Perichaetia terminal, leaves undifferentiated. *Seta* 15–20 mm long, red-brown; capsule cylindrical, 3–4 mm long, red-brown; peristome reddish yellow to white, 0,8–1,0 mm high, teeth papillose, filamentous above a high, obliquely tessellated basal membrane; operculum conical, 1,0–1,5 mm long; spores round, 10–15 μm, almost smooth. Fig. 63: 17–23.

Tortula princeps is a very widespread species in temperate regions of both hemispheres. In Southern Africa *T. princeps* has been occasionally collected in shrublands of the western Cape Province. Map 80.

Vouchers: *Garside* 6708; *Lavranos* 15202a; *Wager* 632.

The Southern African specimens are not always clearly separated from *T. ruralis*. In the absence of the synoicous inflorescence, a large number of characters must be assessed to separate the species. Many of the recent collections are satisfactorily placed, but a few sterile specimens have been collected that appear to be intermediate between the two species.

8. **Tortula ruralis** (*Hedw.*) *Gaertn., Meyer & Scherb.* in Oek, Techn. Fl. Wetterau 3: 91 (1802); Broth. in Natürl. PflFam. 1: 434 (1902); 10: 301 (1924); Sim, Bryo. S. Afr. 226 (1926). Type: Germany.

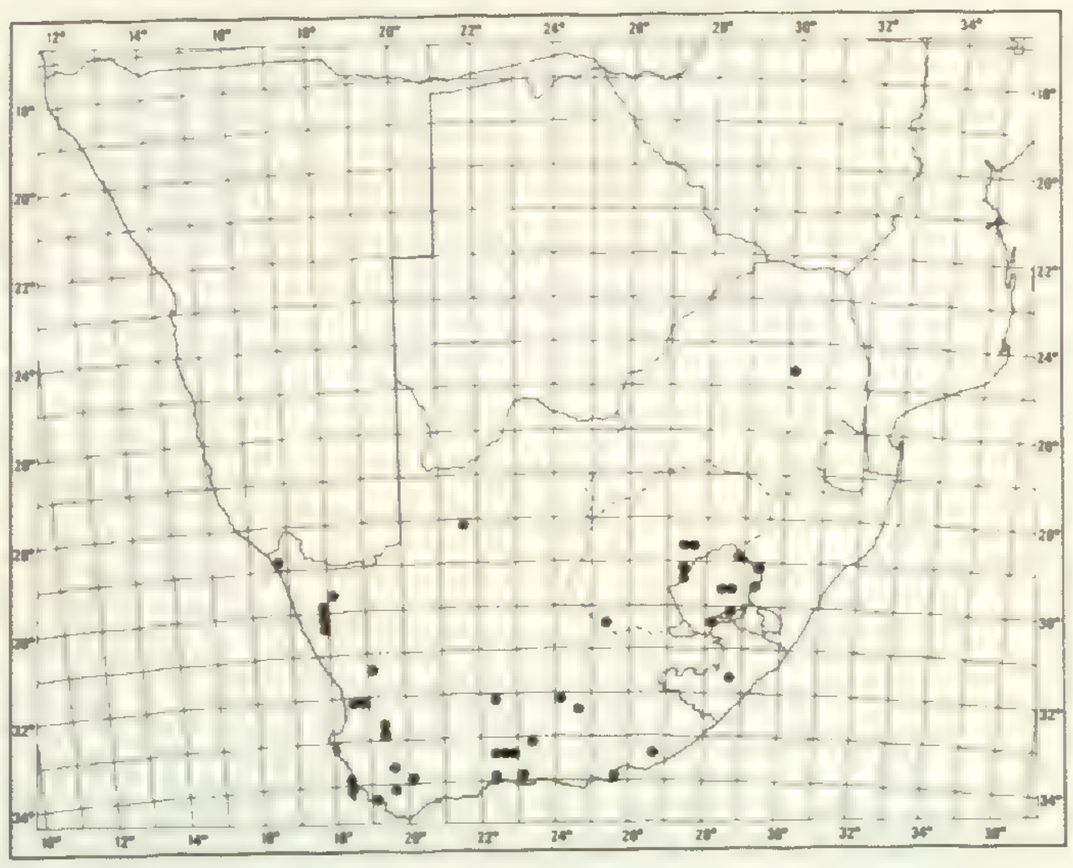
Barbula ruralis Hedw., Sp. Musc. 121 (1801).

Barbula afroruralis C. Müll. in Hedwigia 38: 101 (1899). *Tortula afroruralis* (C. Müll.) Broth. in Natürl. PflFam. 1: 435 (1902). Type: Cape, Stinkwater, *Rehmann* 114 (PRE!; NH!).

Barbula erythroneura C. Müll. in Hedwigia 38: 102 (1899). *Tortula erythroneura* (C. Müll.) Broth. in Natürl. PflFam. 1: 435 (1902). Type: Cape, Groenekloof, *Breutel* s.n., 1862.

Tortula trachyneura Dix. in Trans. R. Soc. S. Afr. 8: 195 (1920). Type: Cape, Tjumie, *D. Henderson* 330 (BM, holo.!).

Plants large, in loose tufts, green to brownish green; terricolous or saxicolous. *Stems* 5–15 mm tall, branching, tomentose below, tomentum rarely gemmiferous; in section without obvious central strand, inner cortical cells large, thin-walled, outer cortical cells in 1–3 rows, smaller, incrassate, reddish. *Leaves* appressed, rarely bistratose, mostly contorted dry, recurved to squarrose wet; oblong-spathulate, 2–3 mm long; apex emarginate or truncate, frequently asymmetrical; margins revolute to upper leaf, frequently to apex; base appressed. *Costa* long-excurrent as hyaline, dentate awn, 2–3 mm long; ventral superficial cells quadrate to short-rectangular, thin-walled, papillose, dorsal superficial cells elongate, incrassate, smooth to rough or spinose; in section guide cells 2, ventral cells in 1–2 layers, large ventral surface cells papillose, dorsal stereid band 4–5 cells thick, reddish, dorsal surface cells generally hyaline, smooth, papillose or spinose. *Laminal cells* hexagonal, densely papillose, with 4–10



MAP 84.— ● **Tortula ruralis**

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C-shaped papillae over lumen; basal cells large, in well defined group, rectangular, hyaline, smooth; basal marginal cells quadrate, chlorophyllous, papillose. *Gemmae* round, multicellular, 50–60 μm, green, rarely on tomentum of lower stem or ventral costal surface.

Dioicous. Perichaetia terminal, leaves undifferentiated. *Seta* 10 mm long, reddish brown; capsule cylindrical, 2–3 mm long, brownish; peristome reddish to white, 1,5 mm high, basal membrane long, obliquely tessellated, teeth long-filamentous, papillose; operculum conical, 1 mm long; spores 12–15 μm, finely granular. Fig. 63: 24–32.

Widespread in Europe, Asia and North America, *T. ruralis* is less common in Southern Africa and Patagonia. The species, growing on soil and rock in shrubland or grassland, has been collected in a few locations in the Transvaal, Orange Free State, northern Cape, Lesotho and Transkei. It is more common in the southern and western Cape. Map 84.

Vouchers: *Esterhuysen* 20600; *Hardy* 4315; *Lyle* 7078; *Magill* 3293, 4525, 6120; *Schelpe* 7816.

The large, squarrose leaves with strongly spinose awn and the dioicous condition characterize this species. The strongly spinose, dorsal costa (*T. trachyneura* Dix.) is seen as only a modification, as are the bistratose leaves found in several arid region collections. Sporophyte production and occurrence of rhizoid or costal gemmae are rare in this species in Southern Africa.

9. HUSNOTIELLA

Husnotiella *Card.* in Rev. Bryol. 36: 71 (1909); Broth. in Natürl. PflFam. 10: 256 (1924). Type species: *H. revoluta* Card.

Plants small to very small, in cushions, green; on soil or soil over rock. *Stems* erect, branching; with central strand. *Leaves* appressed dry, erect to recurved wet; lingulate to oval-lanceolate; apex broadly acute to rounded; margins recurved, entire to crenulate. *Costa* ending below apex; in section round, cells scarcely differentiated, incrassate. *Laminal cells* rounded, quadrate to hexagonal, incrassate, smooth or papillose; basal cells rectangular, thin-walled, smooth.

Apparently dioicous. Perichaetial leaves generally distinct. *Seta* erect, 5–9 mm long, capsule cylindrical to ovate, smooth or weakly plicate, gymnostomous; operculum rostrate; calyptra cucullate; spores round, smooth to granulate.

The genus *Husnotiella* contains approximately seven species. With the exception of the two Southern African species, the genus is strictly American in its distribution.

1 Leaf cells smooth ..... 1. *H. latifolia*
1 Leaf cells papillose ..... 2. *H. plicata*

1. **Husnotiella latifolia** (*Dix.*) *Zander & Magill* in Mem. bot. Surv. S. Afr. 43: 7 (1979). Type: Zimbabwe, Victoria Falls, *Sim* 8931 (BM, holo.!; PRE!).

Gyroweisia latifolia Dix. in S. Afr. J. Sci. 18: 309 (1922); Sim, Bryo. S. Afr. 251 (1926).

Gyroweisia amplexicaulis Sim, Bryo. S. Afr. 250 (1926). Type: Natal, Van Reenen, *Wager* 414 (PRE, holo.!).

FIG. 63.—**Tortula pagorum** (1–8): **1.** habit, ×1; **2.** habit, plant with apical propagulae, ×10; **3.** leaf, ×20; **4.** leaf in cross section, ×200; **5.** basal leaf cells (upper right side), ×170; **6.** upper laminal cells, ×640; **7.** leaf apex (left side), ×170; **8.** propagulum, ×140. **T. papillosa** (9–16): **9.** habit, ×1; **10.** habit, ×10; **11.** stem in cross section, ×85; **12.** leaf, ×20; **13.** leaf in distal cross section, ×170; **14.** upper laminal cells, ×640; **15.** cells at leaf apex, ×170; **16.** gemmae, ×200. **T. princeps** (17–23): **17.** habit, ×1; **18.** leaf, ×20; **19.** leaf in cross section, ×200; **20.** cells at basal leaf margin, ×170; **21.** upper laminal cells, ×640; **22.** part of capsule mouth with peristome teeth, ×30; **23.** young sporophyte at stem apex with surrounding archegonia, antheridia and paraphyses, ×30. **T. ruralis** (24–32): **24.** habit, ×1; **25.** base of plant showing attachment of rhizoid gemmae, ×3; **26.** leaf (ventral surface), ×20; **27.** leaf with smooth costa (side view), ×20; **28.** leaf with scabrous costa (side view), ×20; **29.** leaf in cross section (scabrous costa form), ×170; **30.** upper laminal cells, ×640; **31.** archegonia and paraphyses at stem apex, ×30; **32.** rhizoid gemmae, ×170. (1–8, *Magill* 3820; 9–16, *Ellis* 3092; 17–23, *Ecklon* s.n.; 24, 26–27 & 30–31, *Magill* 6120; 25 & 32, *Barnard* 50349; 28–29, *Magill* 4036).

Plants very small, forming small cushions, green above, brownish below; terricolous. *Stems* erect, 3–4 mm high, branched; in section oval, central strand present, inner cortical cells large, thin-walled, outer cortical cells in 2–3 rows, smaller, incrassate, reddish. *Leaves* appressed, weakly twisted around stem dry, widespreading to recurved wet; lingulate to broadly ovate-lanceolate, 0,5–1,0 mm long; apex rounded to obtuse; margins entire, recurved from base to near apex or infrequently reflexed to plane in some leaves. *Costa* ending well below apex; ventral and dorsal superficial cells rounded-quadrate above, rectangular below, smooth; in section round, guide cells 2–3, incrassate, slightly larger than other cells, ventral surface cells incrassate, smooth, dorsal substereid band of 2–3 cells, dorsal surface cells incrassate, smooth. *Upper laminal cells* rounded-quadrate to angular, incrassate, smooth; basal cells not differentiated or rectangular, thin-walled, smooth. *Gemmae* infrequent, axillary, multicellular, obovoid, 60–65 μm, brownish.

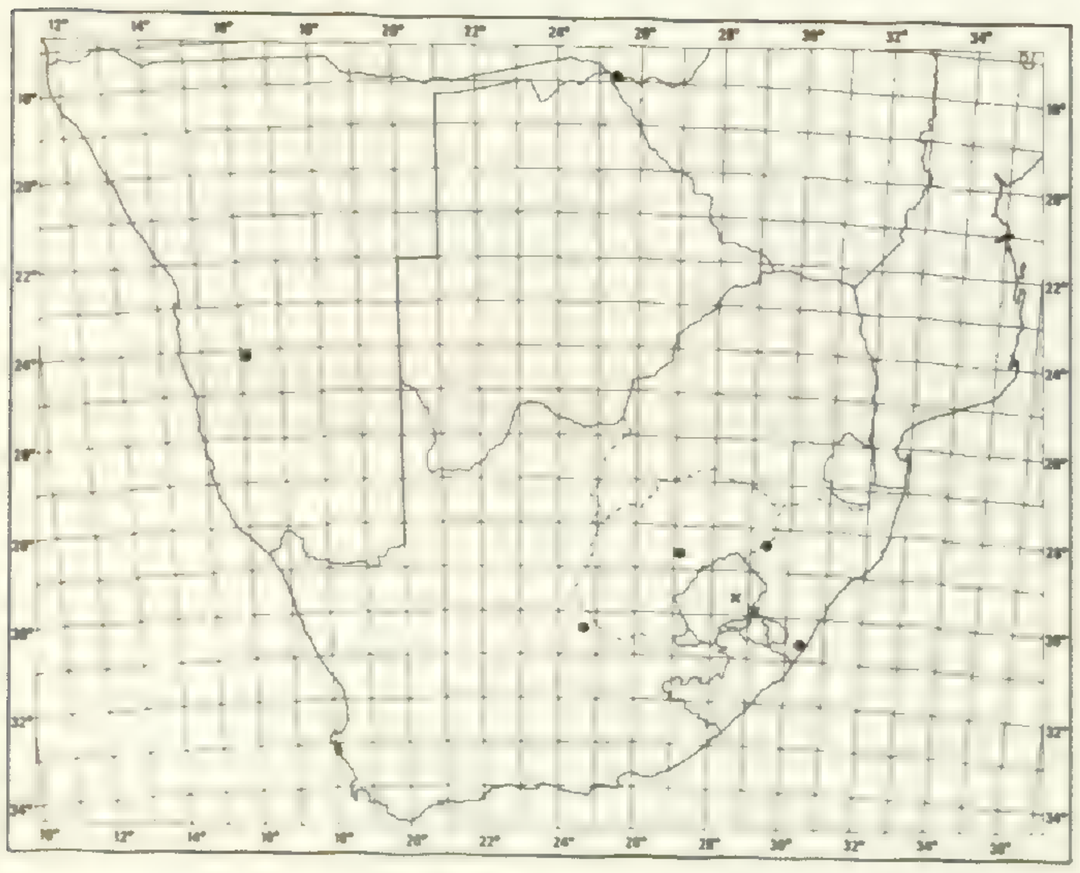
This species is known from Zimbabwe and South Africa. Apparently rare, *H. latifolia* has been collected in grasslands of Natal, and a few sites in the central Cape, Orange Free State and South West Africa/ Namibia. Map 85.

Vouchers: *Rehmann* 459; *Vahrmeijer* PRE-CH 12669a.

Husnotiella latifolia is similar to the American species *H. obtusifolia* (Broth.) Zander (Zander, pers. comm.). The smooth leaf cells and non-plicate capsules help to separate *H. latifolia* from the other Southern African species.

2. **Husnotiella plicata** *Magill*, sp. nov., *habitu* H. latifolia (*Dix.*) *Zander & Magill similis, sed foliis majoribus cellulis laminae papillosis, foliis perichaetii cellulis chlorophyllosis restrictis ad partem distalem folii et capsulis plicis longitudinalibus distinctis formatis seriebus cellulorum dissimilium exothecii differt.*

Type: Lesotho, 210 km E. of Maseru along Mountain Road, 1 km E. of Taung, on soil in small canyon along Orange River, *Magill* 4216 (PRE, holo.; H; MO; NY).



MAP 85.— ● **Husnotiella latifolia**
× **Husnotiella plicata**

Dioicous? Perichaetia terminal, leaves oblong, 0,5–1,0 mm long; apex rounded; chlorophyllous cells in distal $\frac{2}{3}$ of leaf. *Seta* 5–6 mm long, reddish yellow; capsule short-cylindrical, 1 mm long, reddish yellow; peristome absent; operculum rostrate, to 0,4 mm long, ± oblique; calyptra not seen; spores round, 16–18 μm, granulate. Fig. 64: 1–9.

Plants small, in loose cushions or tufts, green above, brownish below; terricolous. *Stems* erect, 3–4 mm high, occasionally branched; in section round, central strand present, inner cortical cells large, thin-walled, in 2–3 rows, outer cortical cells in 3–4 rows, smaller, incrassate. *Leaves* appressed dry, erect-spreading wet; lingulate to oval-lanceolate, 0,5–1,2 mm long; apex acute to obtuse, rarely rounded in some leaves; margins generally reflexed from base to near apex, minutely crenulate by marginal cell papillae. *Costa* ending below apex; ventral superficial cells rectangular to short-rectangular, sparsely papillose, dorsal superficial cells rectangular, papillose; in section round, cells scarcely differentiated, guide cells 2, ventral cells 1–2, in single layer, incrassate, papillose, dorsal substereid band small, of 3–4 cells, frequently absent, dorsal surface cells ± 6, incrassate, papillose. *Upper laminal cells* rounded-hexagonal, incrassate, with a single low, blunt papilla over lumen; basal cells rectangular, ± incrassate, smooth.

Dioicous. Perichaetia quickly lateral through innovation, leaves oblong, 1,0–1,2 mm long; apex obtuse; chlorophyllous cells restricted to upper $\frac{1}{3}$ of leaf; lower cells

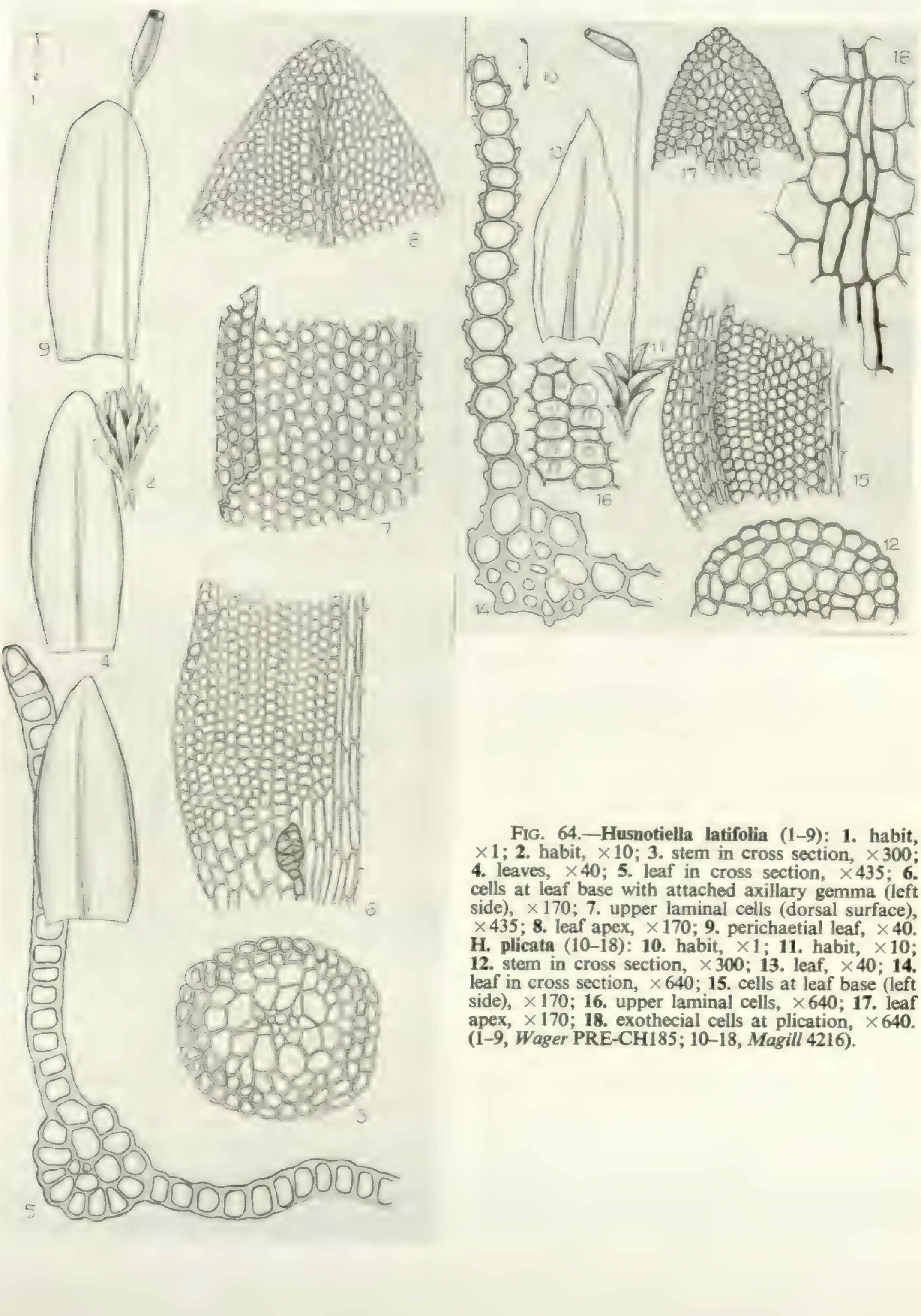


FIG. 64.—**Husnotiella latifolia** (1–9): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×300; **4.** leaves, ×40; **5.** leaf in cross section, ×435; **6.** cells at leaf base with attached axillary gemma (left side), ×170; **7.** upper laminal cells (dorsal surface), ×435; **8.** leaf apex, ×170; **9.** perichaetial leaf, ×40. **H. plicata** (10–18): **10.** habit, ×1; **11.** habit, ×10; **12.** stem in cross section, ×300; **13.** leaf, ×40; **14.** leaf in cross section, ×640; **15.** cells at leaf base (left side), ×170; **16.** upper laminal cells, ×640; **17.** leaf apex, ×170; **18.** exothecial cells at plication, ×640. (1–9, *Wager* PRE-CH185; 10–18, *Magill* 4216).

narrowly rectangular. *Seta* 6–9 mm long, reddish yellow; capsule ovate to cylindrical, narrowing to mouth, 0,8–1,5 mm long; exothecial cells quadrate, distinct longitudinal plications of urn formed by linear cells in single, vertical row; peristome absent; operculum rostrate, 0,4–0,6 mm long; calyptra cucullate, only observed on very young capsules; spores round, 15 μm, ± smooth. Fig. 64: 10–18.

This new species was collected on soil in a small kloof in semi-arid subalpine grassland above the Orange River in central Lesotho. A subsequent collection was made at Sehlabathebe National Park in southeastern Lesotho. Map 85.

Vouchers: *Magill* 4209, 4326.

Similar to *H. latifolia*, this species differs in its larger leaves with papillose leaf cells, its perichaetial leaves with chlorophyllous cells restricted to the distal ⅓ of the leaf, and a capsule with distinct longitudinal plications formed by rows of differentiated exothecial cells.

10. WEISIOPSIS

Weisiopsis *Broth.* in Öfvers. finska VetenskSoc. Förh. 62A: 7 (1921); Broth. in Natürl. PflFam. 10: 270 (1924); Sim, Bryo. S. Afr. 224 (1926); Saito in J. Hattori bot. Lab. 39: 525 (1975). Type species: *W. anomala* (Broth. & Par.) Broth.

Plants small, caespitose or gregarious, olive-green to brownish green; saxicolous. *Stems* 2–4 mm high, generally simple; central strand very small or absent. *Leaves* crisped to spirally twisted with involute lamina dry, erect-spreading wet; obovate, spathulate or narrowly elliptical, 1–4 mm long; apex rounded or acute; margins plane or involute, entire. *Costa* ending below apex or percurrent; with dorsal stereid band only. *Laminal cells* ± rounded, quadrate to hexagonal, incrassate, mammillose ventrally; basal cells lax. *Gemmae* infrequent, cylindrical.

Monoicous or dioicous. Perichaetial leaves undifferentiated. *Seta* erect, 3,5–6,0 mm long; capsule cylindrical to ovoid, 1,0–1,8 mm long; peristome teeth irregularly cleft or perforated, papillose; operculum obliquely rostrate; calyptra cucullate; spores round, granulate.

The genus *Weisiopsis* comprises 10 species that are found in Central America and northern South America, the West Indies, Africa south of the Sahara, India, Asia and Oceania. The African plants grow on rock or coarse soils from Tanzania south to Zimbabwe, Botswana and South Africa.

1 Leaf margins involute ..... 3. *W. involuta*
1 Leaf margins plane:
  2 Leaves broadly spathulate ..... 1. *W. plicata*
  2 Leaves narrowly elliptical ..... 2. *W. pulchriretis*

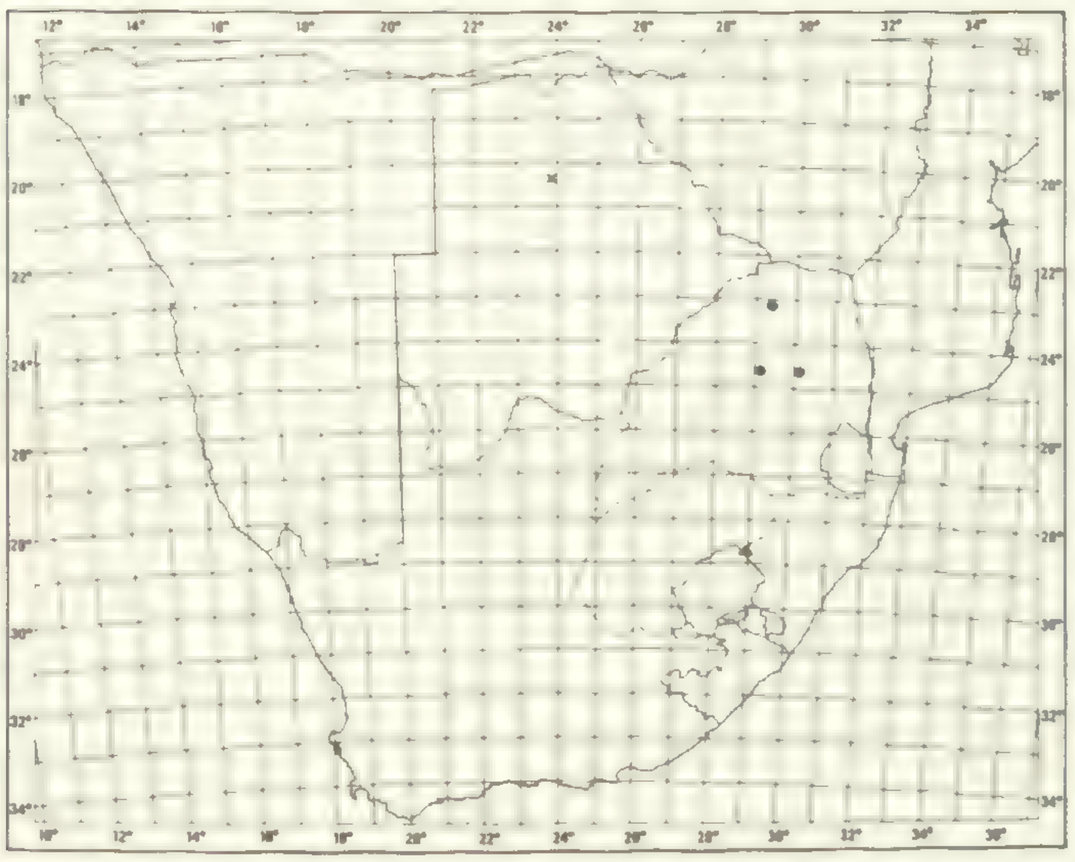
1. **Weisiopsis plicata** (*Mitt.*) *Broth.* in Öfvers. finska VetenskSoc. Förh. 62A: 8 (1921); Broth. in Natürl. PflFam. 10: 270 (1924); Sim, Bryo. S. Afr. 224 (1926). Type: Tanzania, Usagara Mountains, *Hannington* s.n. (NY, holo.!).

Hyophila plicata Mitt. in J. Linn. Soc., Bot. 22: 304 (1886).

Plants small, gregarious or forming small groups, olive-green, glossy; saxicolous or terricolous. *Stems* 3–4 mm tall, simple; in section round, central strand present, small, cortical cells small, thin-walled, becoming incrassate toward margin. *Leaves* crisped, lamina widely involute dry, erect-spreading wet; obovate, spathulate or elliptical, 1,5–2,5 mm long; apex obtuse to rounded; margins plane, entire. *Costa* ending below apex or percurrent; ventral superficial cells rounded-quadrate, somewhat thickened, dorsal superficial cells rectangular, incrassate; in section round, guide cells 4, small, ventral cells in single layer, similar to laminal cells, dorsal stereid band 4–5 cells thick, dorsal surface cells substereids, sometimes as large as guide cells. *Upper laminal cells* rounded-quadrate, rarely angular, incrassate, mammillose ventrally, smooth dorsally; basal cells large, lax, rectangular; basal marginal cells much smaller, quadrate to rectangular.

Autoicous. Perichaetial leaves undifferentiated. *Seta* 3,5 mm long, yellowish; capsule weakly plicate dry, cylindrical-ovoid, 1,6–1,8 mm long, red-brown; peristome irregular, teeth linear, 0,2 mm high, sometimes perforated below, granulate, light orange; operculum rostrate, 0,5 mm long; spores round, 10–12 μm, granulate. Fig. 65: 1–10.

Previously known only from eastern Africa, Zimbabwe and the East African Islands, *W. plicata* has recently been discovered in forests of the northern and eastern Transvaal. Map 86.



MAP 86.— ● **Weisiopsis plicata**
× **Weisiopsis pulchriretis**
▲ **Weisiopsis involuta**

Vouchers: *Magill* 3149, 3773, 3782.

The large, spathulate leaves and distinctly plicate capsules distinguish *W. plicata* from the other Southern African species. The species could be mistaken for a *Hyophila* when sterile, but costal anatomy will separate the two genera.

2. Weisiopsis pulchriretis *Dix.* in Trans. R. Soc. S. Afr. 18: 252 (1930). Type: Natal, Natal National Park, *Wager* 739 (BM, holo.; PRE!).

Plants small, caespitose, dark green; saxicolous. *Stems* 2–4 mm long, simple; in section without distinct central strand, cortical cells small, somewhat thickened toward margin. *Leaves* incurled, crisped dry, widespreading wet; narrowly elliptical, 2,5–4,0 mm long; apex acute; margins plane, entire. *Costa* percurrent to mucronate; ventral superficial cells quadrate to short-rectangular, smooth, thin-walled, dorsal superficial cells elongate, incrassate, smooth; in section round, guide cells 4, ventral cells in 2–3 layers, similar to guide cells or slightly larger, dorsal stereid band 3–4 cells thick. *Upper laminal cells* hexagonal to quadrate, incrassate, mammillose ventrally, smooth to weakly mammillose dorsally; basal cells rectangular to elongate-hexagonal, thin-walled, hyaline, narrower at margins, extending up margin to form distinct V-shaped area.

Paroicous. Antheridia in axils of perichaetial and subperichaetial leaves. Perichaetia terminal; leaves undifferentiated. *Seta* 3–5 mm long, yellowish; capsule ovoid to short-cylindrical, 1,0–1,5 mm long, yellow-brown; peristome fragile, described as rudimentary, only basal fragments observed; operculum and calyptra not seen; spores round, 10–12 μm, granulate. Fig. 65: 11–17.

Endemic to Southern Africa, the species has only been collected in the Goodoo Forest of Natal. Map 86.

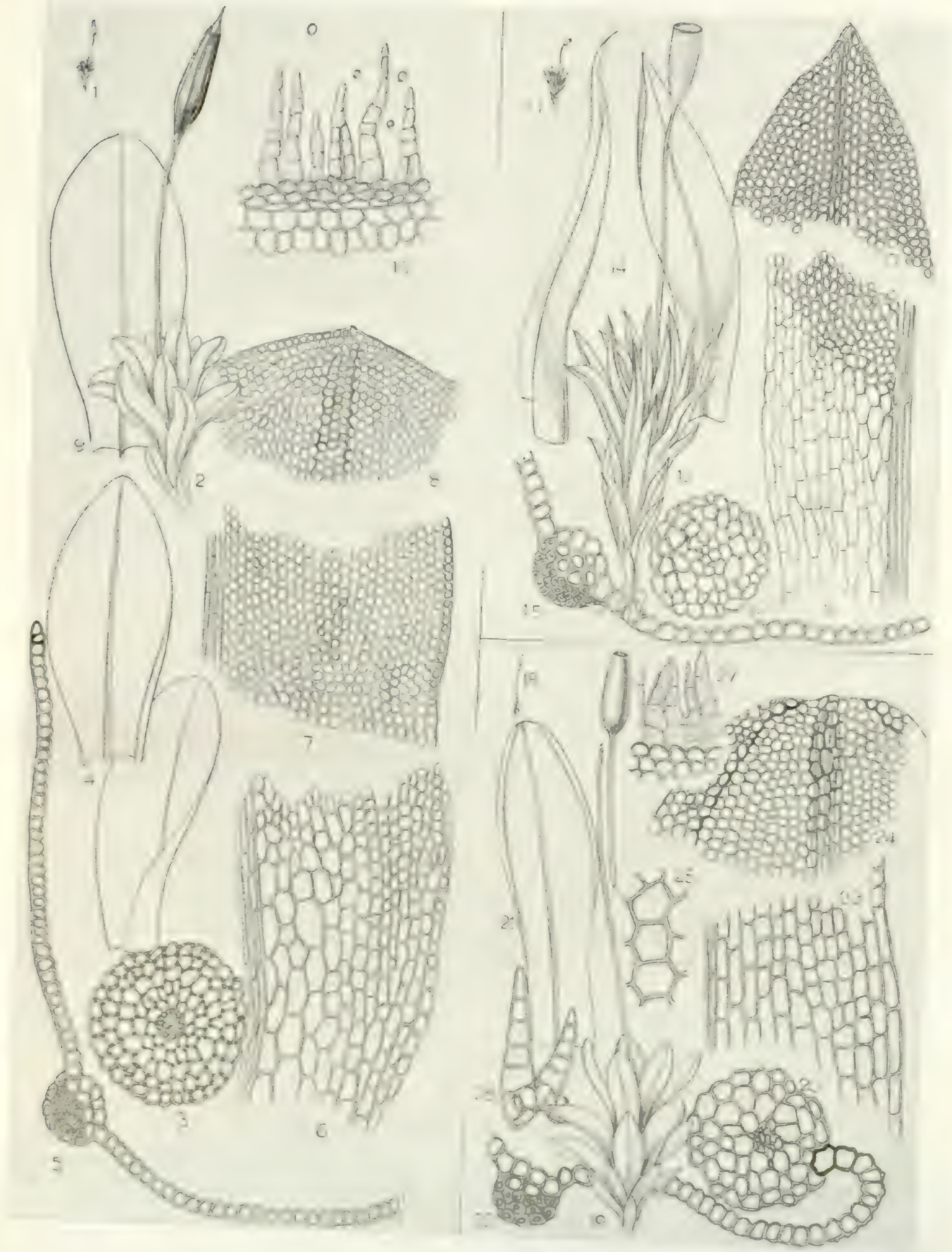
Voucher: Type only.

The narrowly elliptical leaves, extension of basal leaf cells up the margins and paroicous condition will help to identify this species. These characters make *W. pulchriretis* unique in the genus. However, the mammillose leaf cells, costal anatomy and sporophyte indicate that the species is correctly placed in *Weisiopsis*.

3. **Weisiopsis involuta** *Magill*, sp. nov., W. plicata (*Mitt.*) *Broth. habitu, anatomia costae et cellulis laminae mammillosis ventraliter similis, sed marginibus folii late involutis, gemmis echinatis, setis longioribus et capsulis non plicatis differt.*

Type: Botswana, Boteti River, on near-vertical cliff face along river, *Smith* 2603a (PRE, holo.; H; MO; NY; SRGH).

Plants small, forming sods, brownish green; saxicolous. *Stems* 2,5–3,5 mm high, rarely branched; in section round, central strand present, very small, inner cortical cells large, outer cortical cells smaller, incrassate. *Leaves* spirally twisted around stem to crisped, lamina widely involute dry, erect-spreading wet; spathulate, 0,8–1,2 mm long; apex ruonded; margins involute above. *Costa* percurrent to ending below apex; ventral superficial cells quadrate, thin-walled, mammillose, dorsal superficial cells rectangular, incrassate, weakly prorate; in section round, guide cells 2, ventral cells in single row,



similar to laminal cells, dorsal stereid band 2–3 cells thick, dorsal surface cells substereids. *Upper laminal cells* quadrate to rounded-quadrate, incrassate, mammillose ventrally, some cells with single, small papilla on dorsal surface; marginal cells frequently with several papillae; basal cells larger, quadrate to rectangular, smooth. *Gemmae* infrequent, cylindrical, echinate, 150–200 μm long.

Dioicous. Plants undifferentiated. Perigonium terminal, perigonial leaves with oval bases. Perichaetia terminal, perichaetial leaves lingulate, 1,0–1,5 mm long. *Seta* 4,5–6,5 mm long, brownish; capsule ovate to elliptical, 1,0–1,2 mm long, brownish yellow; peristome yellowish, teeth irregularly cleft above, fragile, united at base forming a short basal membrane, papillose; operculum obliquely rostrate, 0,5 mm long; spores round, 10–12 μm, granulate. Fig. 65: 18–27.

This new species is presently known only from northern Botswana. The type locality is a near-vertical, soft, crumbly calcrete cliff along the Boteti River. Map 86.

Voucher: Type only.

The small size of the plants, broadly involute leaf margins, production of gemmae, long seta, and smooth capsules separate *W. involuta* from other species of *Weisiopsis*. The spathulate leaves, costal anatomy, small mammillose laminal cells and presence of a peristome indicate that the species belongs in *Weisiopsis*.

Tribe **BARBULEAE**

Plants small to medium, in loose tufts; terricolous or saxicolous. *Stems* erect; centra strand present. *Leaves* frequently board; lanceolate to ovate-ligulate or elliptical to oblong; margins plane to recurved or revolute. *Costa* ending below apex to long-excurrent; generally with dorsal and ventral stereid bands. *Laminal cells* generally thickened, smooth to mammillose or papillose.

Capsule stegocarpic; peristome present or absent, teeth generally filiform, erect or twisted; operculum conic to rostrate; calyptra cucullate.

Key to Genera of Tribe Barbuleae

1 Leaves broadly elliptical; apex broadly acute to obtuse; margins narrowly involute when dry; laminal cells strongly mammillose ventrally; peristome absent..... 1. **Hyophila**

1 Leaves narrower, margins plane to revolute wet or dry; laminal cells generally papillose or mammillose on both dorsal and ventral surfaces:

2 Upper leaf margins bistratose..... 2. **Trichostomopsis**

2 Upper leaf margins unistratose:

3 Plants generally reddish green; leaf apices with a distinct, clear, smooth apiculus and occasionally one to several smooth, clear marginal teeth; basal leaf cells strongly differentiated..... 5. **Bryoerythrophyllum**

FIG. 65.—**Weisiopsis plicata** (1–10): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×150; **4.** leaves, ×20; **5.** leaf in cross section, ×225; **6.** basal leaf cells (right side), ×170; **7.** upper laminal cells, ×170; **8.** leaf apex, ×170; **9.** perichaetial leaf, ×20; **10.** part of capsule mouth with peristome teeth and spores, ×170. **W. pulchriretis** (11–17): **11.** habit, ×1; **12.** habit, ×10; **13.** stem in cross section, ×150; **14.** leaves, ×20; **15.** leaf in cross section, ×225; **16.** cells at leaf base (left side), ×170; **17.** leaf apex, ×170. **W. involuta** (18–27): **18.** habit, ×1; **19.** habit, ×10; **20.** stem in cross section, ×200; **21.** leaf, ×40; **22.** leaf in cross section, ×260; **23.** cells at leaf base (right side), ×435; **24.** leaf apex, ×435; **25.** upper laminal cells, ×640; **26.** axillary gemmae, ×220; **27.** part of capsule mouth with peristome teeth, ×170. (1–10, *Magill* 3782; 11–17, *Wager* 739; 18–27, *Smith* 2603a).

3 Plants green to brownish green; leaf apices without smooth, clear apiculus or marginal teeth; basal cells usually somewhat differentiated:

4 Axillary hairs with basal cell brownish; ventral superficial costal cells quadrate to short-rectangular ..... 3. **Didymodon**

4 Axillary hairs hyaline throughout; ventral superficial costal cells rectangular to elongate ..... 4. **Barbula**

1. HYOPHILA

Hyophila *Brid.*, Bryo. Univ. 1: 760 (1827); Broth. in Natürl. PflFam. 10: 269 (1924); Gangulee, Moss. E. India 677 (1972). Lectotype species: *H. javanicum* (Nees & Blum.) Brid., vide Hampe in Bot. Ztg 4: 266 (1846).

Plants small to medium, caespitose; saxicolous or terricolous. *Stems* erect, little branched; central strand present. *Leaves* glossy, incurled with involute margins dry, spreading with plane margins wet; broadly oblong or elliptical, sometimes spathulate; apex broadly acute to rounded, mucronate; margins plane, entire or serrate to dentate. *Costa* percurrent or short-excurrent; in section with dorsal and ventral stereid bands. *Laminal cells* small, quadrate or hexagonal, mammillose ventrally, smooth dorsally; basal cells short-rectangular to quadrate, smooth. *Gemmae* infrequent, axillary, polymorphous, multicellular.

Dioicous. Perichaetial leaves undifferentiated. *Seta* short, 8–12 mm long; capsule cylindrical, gymnostomous; operculum rostrate; calyptra cucullate; spores round, essentially smooth.

The approximately 110 species of *Hyophila* are most common in the tropics. A few, rather widespread species, e.g. *H. involuta*, are also present in temperate regions. In Southern Africa the genus is found in Natal and a few locations in the eastern Transvaal.

1 Leaves 2,4 mm long, margins serrate to dentate ..... 1. *H. involuta*

1 Leaves 1,0–1,5 mm long, margins entire or rarely serrulate ..... 2. *H. baginsensis*

1. **Hyophila involuta** (*Hook.*) *Jaeg.* in Verh. St Gall. naturw. Ges. 1871–72: 354 (1873); Saito in J. Hattori bot. Lab. 39: 468 (1975); Gangulee, Moss. E. India 681 (1972). Type: Nepal, *D. Gardner* s.n.

Gymnostomum involutum Hook., Musc. Exot. 2: 154 (1819).

Trichostomum atrovirens Rehm. ex C. Müll. in Hedwigia 38: 100 (1899). *Hyophilia atrovirens* (C. Müll.) Broth. in Natürl. PflFam. 1: 403 (1902); Sim, Bryo. S. Afr. 222 (1926). Type: Natal, Van Reenens Pass, *Rehmann* 119 (PRE!).

Plants small to medium, in loose tufts, blackish green to dark green; saxicolous. *Stems* 5–15 mm tall; in section round, central strand present, inner cortical cells thin-walled, becoming smaller toward margin, incrassate, reddish. *Leaves* glossy, incurled with involute margins dry, spreading with plane margins wet; broadly oblong to elliptical, 2–4 mm long; apex broadly acute, mucronate; margins plane, serrate to dentate in upper leaf. *Costa* subpercurrent to short-excurrent, ventral superficial cells quadrate, mammillose, dorsal superficial cells rectangular, smooth, incrassate; in section round to oval, guide cells 4, small, ventral stereid band small, 2–3 cells thick, ventral surface cells thickened, bulging, dorsal stereid band large, 2–6 cells thick, dorsal surface cells substereids. *Upper laminal cells* small, hexagonal to subhexagonal or rounded, becoming quadrate below; in section ventral surface mammillose, dorsal surface smooth; basal cells rectangular, smooth. *Gemmae* infrequently produced, axillary, stalked, multicellular, polymorphous.

Dioicous. Perichaetia terminal, leaves undifferentiated. *Seta* erect, to 8 mm long, yellowish; capsule cylindrical, 1,5–1,8 mm long, brownish; peristome absent; operculum rostrate, 0,8 mm long; calyptra cucullate; spores round, 10–13 μm, smooth. Fig. 66: 1–9.

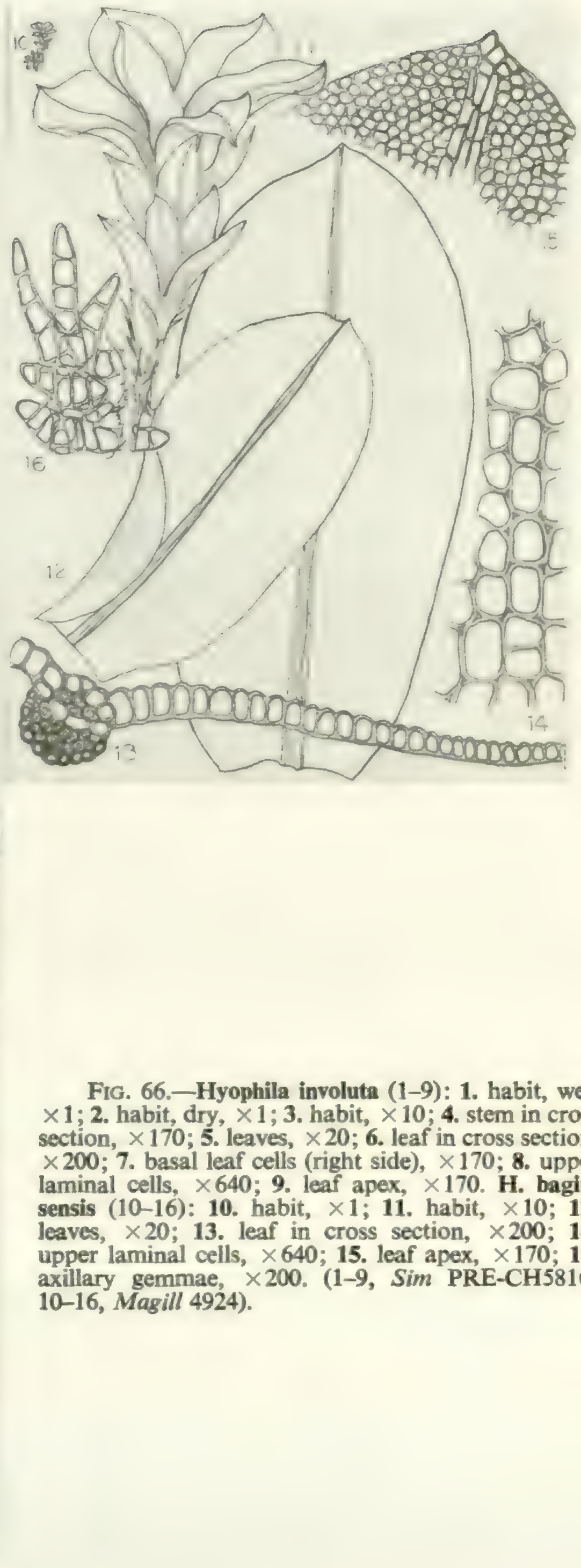
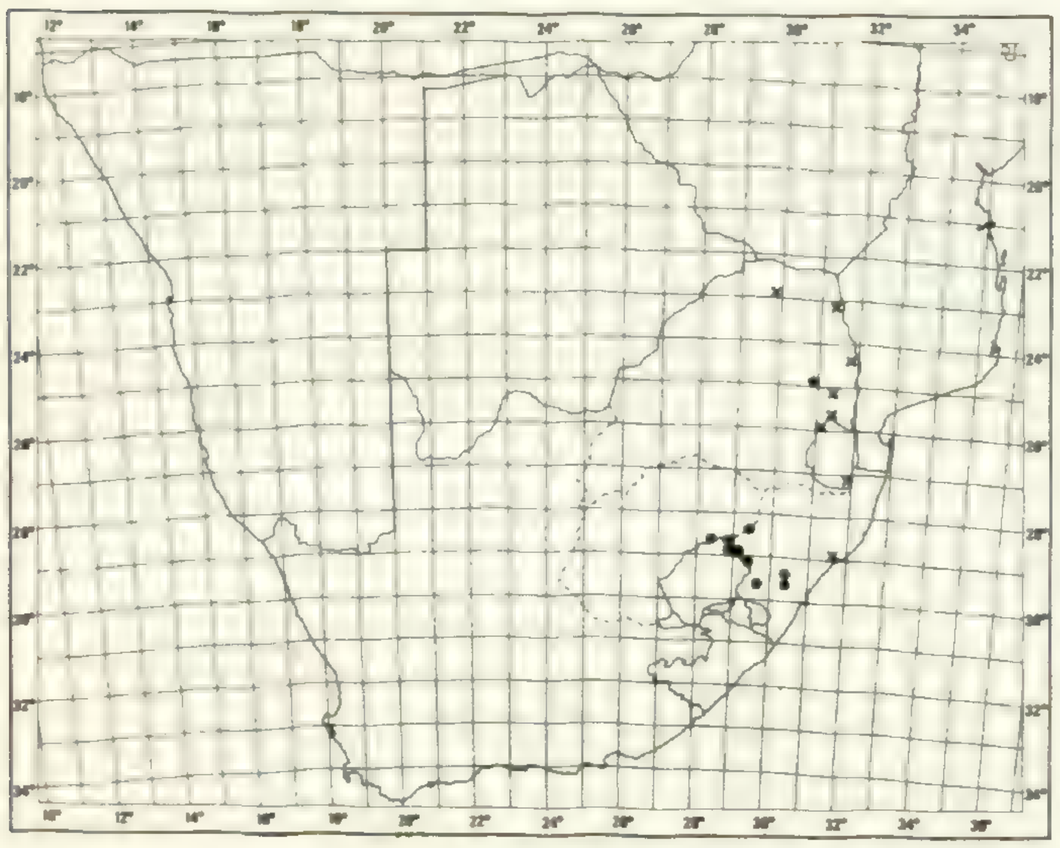


FIG. 66.—**Hyophila involuta** (1–9): **1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, ×10; **4.** stem in cross section, ×170; **5.** leaves, ×20; **6.** leaf in cross section, ×200; **7.** basal leaf cells (right side), ×170; **8.** upper laminal cells, ×640; **9.** leaf apex, ×170. **H. baginsensis** (10–16): **10.** habit, ×1; **11.** habit, ×10; **12.** leaves, ×20; **13.** leaf in cross section, ×200; **14.** upper laminal cells, ×640; **15.** leaf apex, ×170; **16.** axillary gemmae, ×200. (1–9, *Sim* PRE-CH5816; 10–16, *Magill* 4924).

New to Africa, *Hyophila involuta* was previously known from Europe, southern Asia and India, Micronesia and North, Central and South America. It is probable that the species occurs elsewhere in Africa and re-examination of tropical African specimens, especially central African collections of *H. atrovirens*, may provide additional records for this species. In Southern Africa the species is found in forests or grasslands of the Orange Free State, Lesotho, Natal and eastern Transvaal. Map 87.



MAP 87.— ● **Hyophila involuta**
× **Hyophila baginsensis**

Vouchers: *Crosby & Crosby* 7866; *Rankin* 199a; *Scheepers* 1217.

The broad, oblong leaves and serrate to dentate margins will help to identify this species. The other Southern African species has spathulate leaves with more or less entire margins.

2. **Hyophila baginsensis** *C. Müll.* in Linnaea 39: 399 (1875); Broth. in Natürl. PflFam. 10: 270 (1924); Sim, Bryo. S. Afr. 222 (1926). Type: Central Africa, Niam Niam Region, *Bagins* s.n., 27 May 1870.

Plants small, caespitose, dark green to yellowish green; saxicolous or terricolous. *Stems* to 6 mm tall; in section round, central strand present, cortical cells thickened, outer row smaller, incrassate, reddish. *Leaves* glossy, incurled with involute margins dry, widespreading with plane margins wet; broadly elliptical to lingulate or spathulate, 1,0–1,5 mm long; apex rounded to obtuse, mucronate; margins plane, entire or rarely serrulate above. *Costa* very short-excurrent, ventral superficial cells quadrate to short-rectangular, mammillose, dorsal superficial cells linear, incrassate, smooth; in section round, guide cells 4, ventral stereid band 1–2 cells thick, ventral surface cells larger, incrassate, dorsal stereid band large, 4–6 cells thick, dorsal surface cells substereids. *Upper laminal cells* small, rounded-quadrate, mammillose ventrally, smooth dorsally; basal cells short-rectangular to quadrate, thin-walled. *Gemmae* axillary, stalked, stellate, multicellular.

Sporophyte not known from Southern Africa. Described from Zimbabwe (Sim, 1926) as: '*Seta* to 12 mm long; capsule cylindrical, contracted at mouth; peristome absent'. Fig. 66: 10–16.

Growing on soil, *H. baginsensis* occurs in shrub-savanna and forests of central, eastern and Southern Africa. Within the Flora area the species is found in Zululand, Swaziland, and the northern and eastern Transvaal. Map 87.

Vouchers: *Magill* 4746, 4924; *Sim* 7512.

The smaller size and generally entire leaf margins of *H. baginsensis* distinguish it from *H. involuta*. The species could be confused with *Weisiopsis* but presence of a ventral stereid band in the costa and absence of a peristome characterize the species.

2. TRICHOSTOMOPSIS

Trichostomopsis *Card.* in Rev. Bryol. 36: 73 (1909); Broth. in Natürl. PflFam. 10: 264 (1924); Robinson in Phytologia 20: 184 (1970). Type species: *T. crispifolia* Card.

Barbula section *Asteriscium* C. Müll. in Linnaea 42: 342 (1872); Sim, Bryo. S. Afr. 238 (1926).

Plants small, caespitose; terricolous. *Stems* erect, to 10 mm tall, simple; central strand present. *Leaves* lanceolate to ovate; apex acute; margins plane, entire, bistratose. *Costa* percurrent; in section with dorsal stereid band only. *Laminal cells* quadrate to short-rectangular, incrassate, smooth or pleuropapillose; marginal cells smaller; basal cells rectangular, thin-walled; basal marginal cells narrowly rectangular.

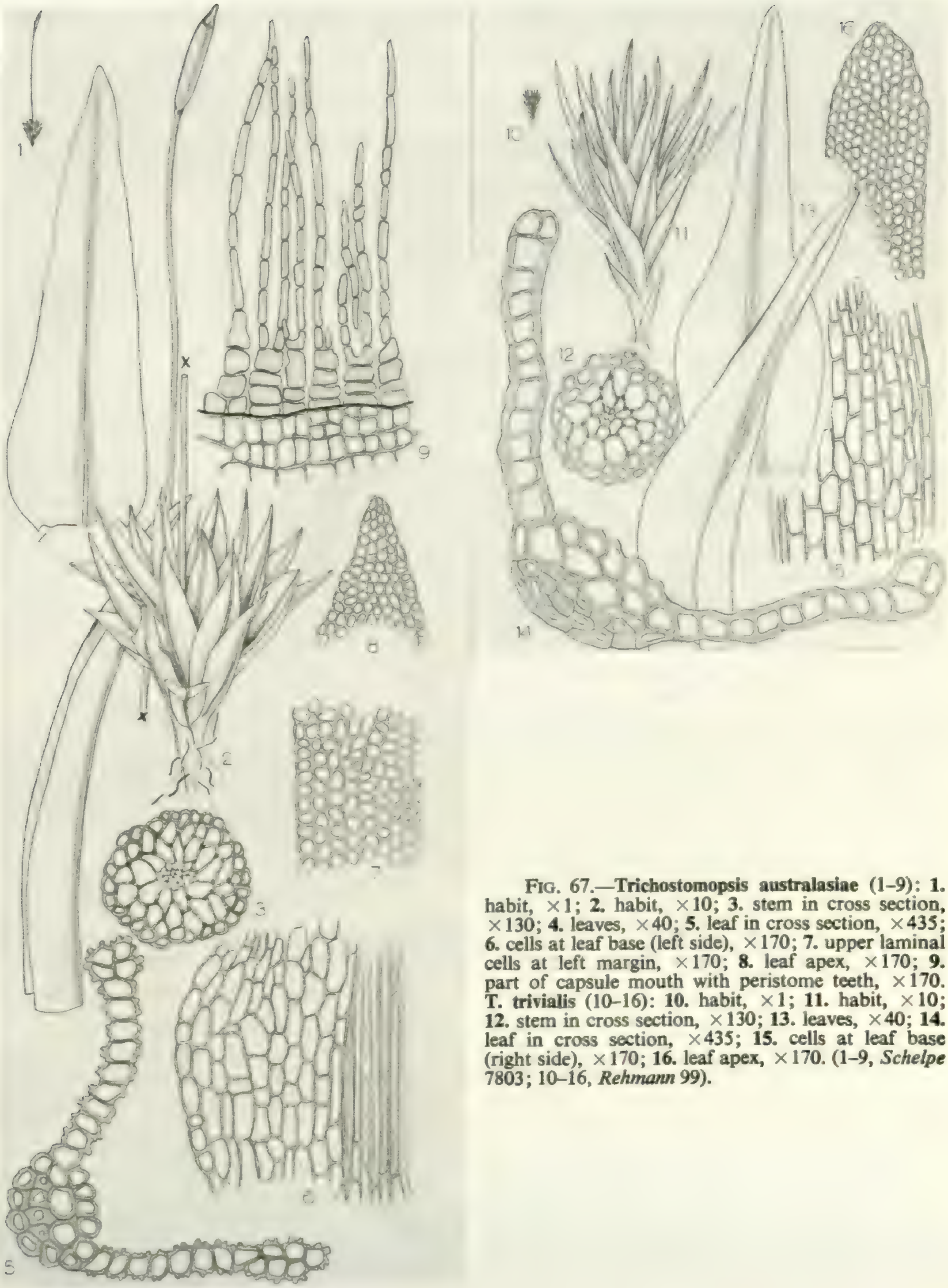


FIG. 67.—**Trichostomopsis australasiae** (1–9): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×130; **4.** leaves, ×40; **5.** leaf in cross section, ×435; **6.** cells at leaf base (left side), ×170; **7.** upper laminal cells at left margin, ×170; **8.** leaf apex, ×170; **9.** part of capsule mouth with peristome teeth, ×170. **T. trivialis** (10–16): **10.** habit, ×1; **11.** habit, ×10; **12.** stem in cross section, ×130; **13.** leaves, ×40; **14.** leaf in cross section, ×435; **15.** cells at leaf base (right side), ×170; **16.** leaf apex, ×170. (1–9, *Schelpe* 7803; 10–16, *Rehmann* 99).

Dioicous. *Capsule* short, cylindrical; peristome teeth divided into 2 linear, papillose filaments, yellowish; operculum rostrate; calyptra cucullate, smooth; spores subround, smooth to granulate.

Trichostomopsis australasiae is a widespread species known from drier parts of both hemispheres. The other four species of *Trichostomopsis* are very restricted in distribution. In Southern Africa, the genus is found in semi-arid regions of the Cape and Orange Free State.

The genus was recently put into the synonomy of *Didymodon* by Zander (1978).

1 Leaf cells papillose ..... 1. *T. australasiae*
1 Leaf cells smooth ..... 2. *T. trivialis*

1. **Trichostomopsis australasiae** (*Hook. & Grev.*) *Robinson* in Phytologia 20: 187 (1970). Type: Australia, King George's Sound, *Menzies* s.n., 1791.

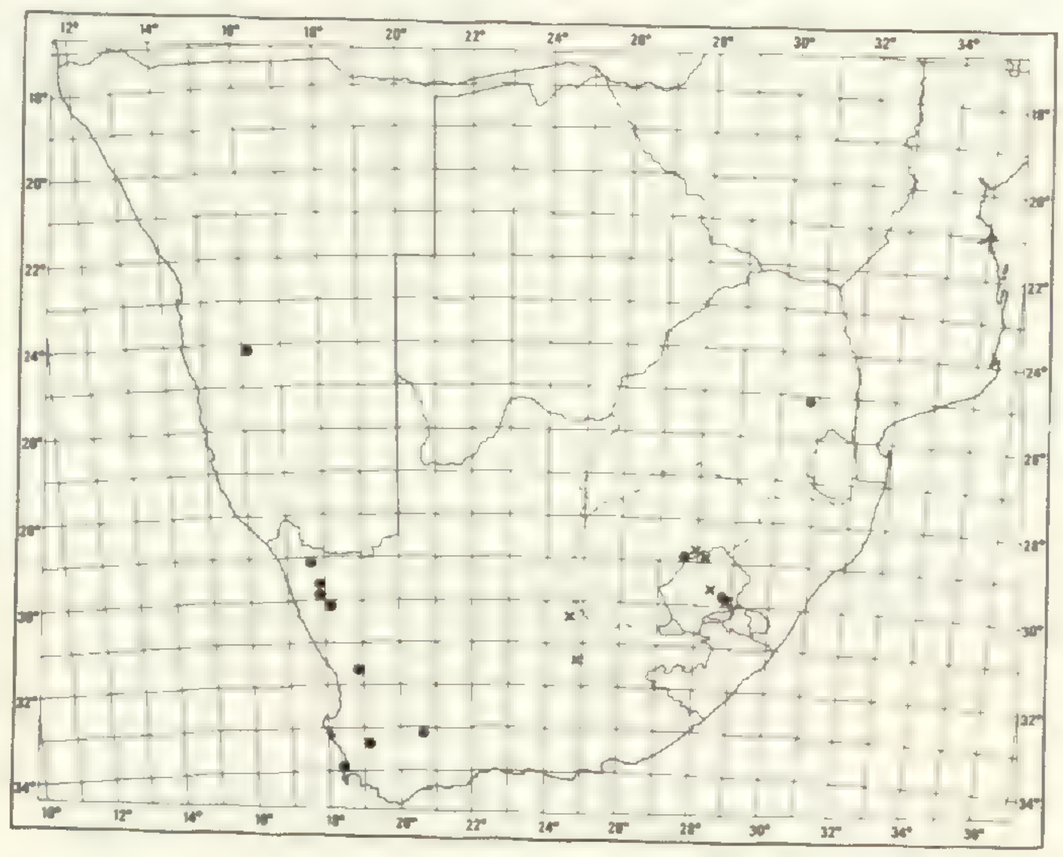
Tortula australasiae Hook. & Grev. in Edinb. J. Sci. 1: 301 (1824). *Barbula australasiae* (Hook. & Grev.) Brid., Bryol. Univ. 1: 828 (1827); Broth. in Natürl. PflFam. 10: 278 (1924).

Barbula trichostomacea C. Müll. in Hedwigia 38: 108 (1899); Sim, Bryo. S. Afr. 238 (1926). Type: Cape, Rondebosch, *Rehmann* 97 (PRE!).

Plants small, caespitose, dark green; terricolous. *Stems* to 10 mm high, simple; in section round, central strand small, inner cortical cells large, weakly thickened, outer cortical cells in 1–2 rows, smaller, incrassate, reddish. *Leaves* incurved to contorted dry, spreading wet; lanceolate, 1–2 mm long, lamina unistratose, rarely with small bistratose areas or bistratose apically; apex acute; margins bistratose above base. *Costa* percurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells short- to long-rectangular, smooth; in section oval, guide cells 2–4, ventral cells in 1(–2) layer(s), incrassate, papillose, dorsal stereid band 1–2 cells thick, dorsal surface cells substereids. *Upper laminal cells* subquadrate, rounded, with 1–4 low, blunt papillae per cell, inconspicuous; basal cells rectangular, thin-walled; basal marginal cells frequently narrower.

Dioicous. Perichaetial leaves undifferentiated. *Seta* 7–8 mm long, dark red; capsule short-cylindrical, 1,5–2,0 mm long; peristome teeth divided to near base, filaments erect, finely papillose; operculum conic, 0,6 mm long; spores subround, 12–17 μm, smooth. Fig. 67: 1–9.

Trichostomopsis australasiae occurs in North, Central and South America, Southern Africa, Australia and New Zealand. In Southern Africa the species is found in the western Cape, Orange Free State, Lesotho, eastern Transvaal and central South West Africa/Namibia. Map 88.



MAP 88.— ● **Trichostomopsis australasiae**
× **Trichostomopsis trivialis**

Vouchers: *Garside* 6505; *Magill & Schelpe* 3880d; *Phelan et al.* 726; *Schelpe* 7755.

The presence of minute leaf cell papillae, although frequently only obvious in transverse sections of the leaves, help to separate this species from *T. trivialis*. The bistratose margins distinguish *T. australasiae* from other related species in the tribe.

2. **Trichostomopsis trivialis** (*C. Müll.*) *Robinson* in Phytologia 20: 187 (1970). Type: Orange Free State, Kadziberg, *Rehmann* 99 (PRE!).

Barbula trivialis C. Müll. in Hedwigia 38: 107 (1899).

Plants small, caespitose, green to yellow-green; terricolous. *Stems* to 10 mm high, simple; in section round, central strand very small, inner cortical cells lax, outer cortical cells in 1–2 rows, small, incrassate, reddish. *Leaves* incurled dry, erect wet; lanceolate to ovate-acuminate, 1,5–2,0 mm long, lamina unistratose; apex broadly acute; margins bistratose, cells slightly smaller than laminal cells. *Costa* percurrent, ventral superficial

cells quadrate, smooth, dorsal superficial cells rectangular, smooth; in section oval, guide cells 4–5, ventral cells in 1(–2) layer(s), large, mammillose, dorsal stereid band 2–3 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* irregularly quadrate to short-rectangular, smooth or nearly so; marginal cells quadrate, smaller; basal cells rectangular, thin-walled; basal marginal cells in 1–3 rows, narrowly rectangular.

Dioicous. Perichaetial leaves undifferentiated. *Seta* 8–10 mm long, reddish yellow; capsule short-cylindrical, 1,5 mm long; peristome divided to base, filaments erect, papillose, yellowish red; operculum rostrate, 0,8 mm long; spores subround, 15 μm, granulate. Fig. 67: 10–16.

Endemic to Southern Africa, the species is known from the central Cape, Orange Free State and Lesotho. The label on the type specimen gives Kadziberg, Orange Free State. Re-examination of Rehmann's route indicates that the Kadziberg is part of the Witteberg in the northeastern Orange Free State, near the Caledon River. Map 88.

Voucher: *Magill* 4255.

The species differs from *T. australasiae* in leaf shape, anatomy and smooth leaf cells.

3. DIDYMODON

Didymodon *Hedw.*, Spec. Musc. 104 (1801); Saito in J. Hattori bot. Lab. 39: 500 (1975). Lectotype species: *D. rigidulus* Hedw., vide Grout, Moss Fl. N. Amer. 1: 186 (1939).

Plants small to medium, forming cushions, yellowish green to dark green, reddish or brownish below; terricolous or saxicolous. *Stems* with central strand; axillary hairs short, basal cells distinct, brownish. *Leaves* appressed, contorted or spirally twisted dry, spreading wet; lanceolate to ligulate; apex acute to rounded; margins entire, reflexed to revolute. *Costa* ending below apex or short-excurrent; in section ventral cells incrassate to substereids, dorsal stereid band strong. *Laminal cells* rounded-quadrate, mammillose to weakly papillose; basal cells rectangular, smooth.

Dioicous. Perichaetia terminal. *Seta* 7–20 mm long; capsule cylindrical; peristome present or absent; operculum rostrate; calyptra cucullate.

The genus *Didymodon* comprises c. 100 species and is found in temperate and tropical regions of continents in both hemispheres (one species reported from Antarctica). The major concentration of species is found in Central and South America.

Saito (1975) considered *Didymodon* a natural genus, closely related to *Barbula*. Another related genus, *Trichostomopsis*, was recently considered to be a synonym of *Didymodon* by Zander (1978). Although the separation of the two genera is not always clear-cut, *Trichostomopsis* has been maintained here. *Didymodon* is separated from *Barbula* by differentiated basal cells of the axillary hairs, quadrate to short-rectangular ventral superficial costal cells and weakly papillose leaf cells. The reflexed to revolute, unistratose leaf margins separate *Didymodon* from *Trichostomopsis*.

1 Leaf apices acute to rounded on same plant; margins plane above, reflexed below..... 1. *D. ceratodonteus*
1 Leaf apices acute to acuminate throughout; margins revolute to spirally revolute in upper leaf..... 2. *D. xanthocarpus*

1. **Didymodon ceratodonteus** (*C. Müll.*) *Dix.* in K. norske Vidensk. Selsk. Skr. 1932 (4): 7 (1932). Type: Cape, Philipstown at Kat River, *Ecklon* s.n. (BM!).

Pottia ceratodontea C. Müll., Syn. Musc. 1: 564 (1849). *Hymenostylium ceratodonteum* (C. Müll.) Broth. in Natürl. PflFam. 1: 389 (1902); Sim, Bryo. S. Afr. 256 (1926).

Trichostomum afrum C. Müll. in Hedwigia 38: 98 (1899). *Didymodon afer* (C. Müll.) Broth. in Natürl. PflFam. 1: 406 (1902). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n. (Herb. Winter).

Barbula dimorpha C. Müll. in Hedwigia 38: 106 (1899). *Didymodon dimorphum* (C. Müll.) Broth. in Natürl. PflFam. 1: 407 (1902). *Gymnostomum dimorphum* (C. Müll.) Sim, Bryo. S. Afr. 259 (1926). Type: Cape, Cape Town, *Rehmann* 102 (BM!).

Didymodon pottsii Dix. in Bull. Torrey bot. Club 43: 193 (1916); *Gymnostomum pottsii* (Dix.) Sim, Bryo. S. Afr. 260 (1926). Type: Orange Free State, Eagle's Nest, Bloemfontein, *Potts* s.n. (*Sim* 8663; PRE!).

Weissia gracilis Wag. & Dix. in Trans. R. Soc. S. Afr. 4: 4 (1914). *Gymnostomum gracile* (Wag. & Dix.) Dix. in Trans. R. Soc. S. Afr. 8: 191 (1920),

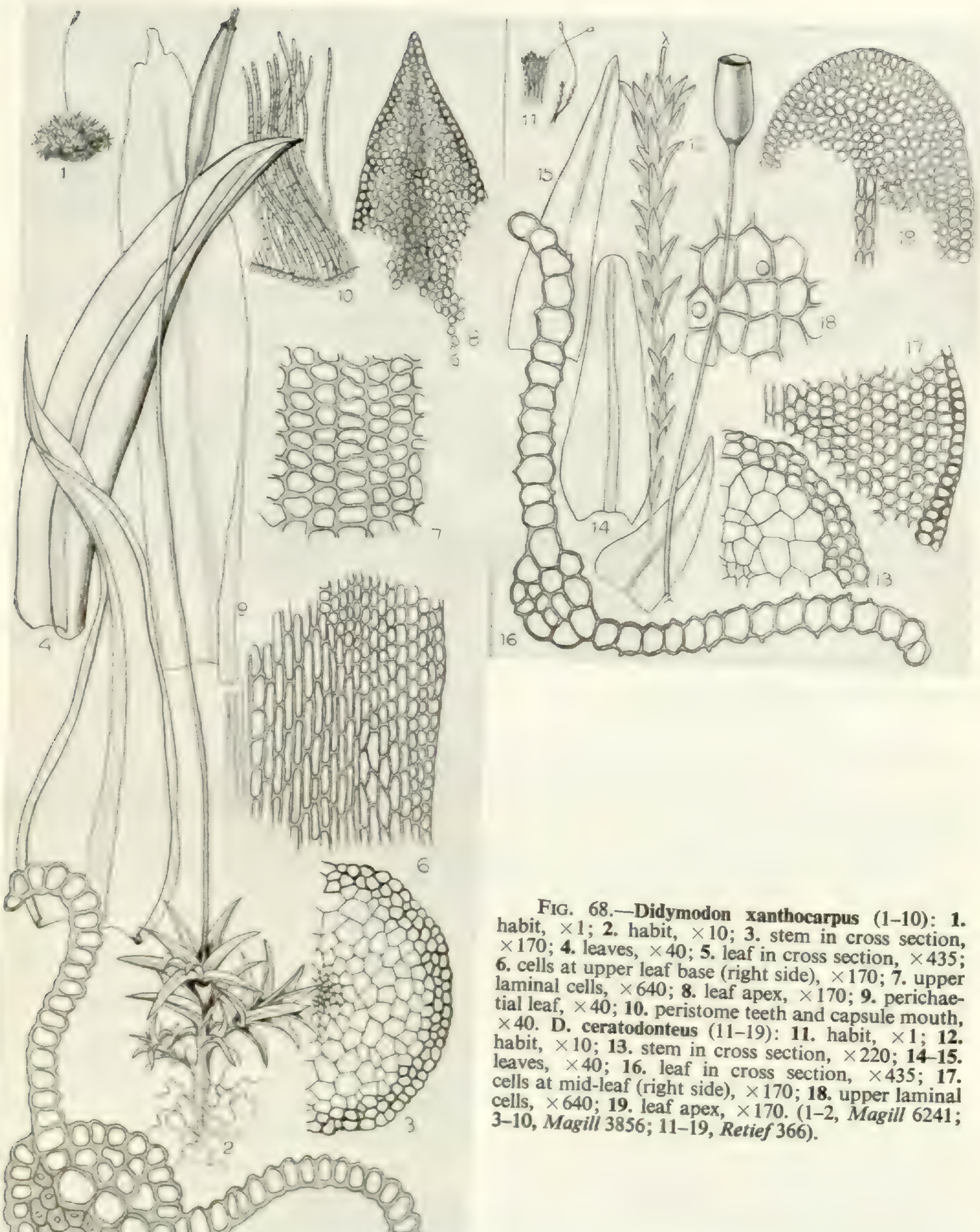


FIG. 68.—**Didymodon xanthocarpus** (1–10): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×170; **4.** leaves, ×40; **5.** leaf in cross section, ×435; **6.** cells at upper leaf base (right side), ×170; **7.** upper laminal cells, ×640; **8.** leaf apex, ×170; **9.** perichaetial leaf, ×40; **10.** peristome teeth and capsule mouth, ×40. **D. ceratodonteus** (11–19): **11.** habit, ×1; **12.** habit, ×10; **13.** stem in cross section, ×220; **14–15.** leaves, ×40; **16.** leaf in cross section, ×435; **17.** cells at mid-leaf (right side), ×170; **18.** upper laminal cells, ×640; **19.** leaf apex, ×170. (1–2, *Magill* 6241; 3–10, *Magill* 3856; 11–19, *Retief* 366).

non *G. gracile* (R. Br.) Hook., Musci Exot. 1: 22 (1818). *Gymnostomum wageri* Schelpe in Mem. bot. Surv. S. Afr. 43: 5 (1979). Type: Transvaal, Pretoria, *Wager* 97 (PRE!).

Hyophila basutensis Sim, Bryo. S. Afr. 223 (1926). Type: Cape, Renosterberg, *Rehmann* 458 (PRE, holo.!).

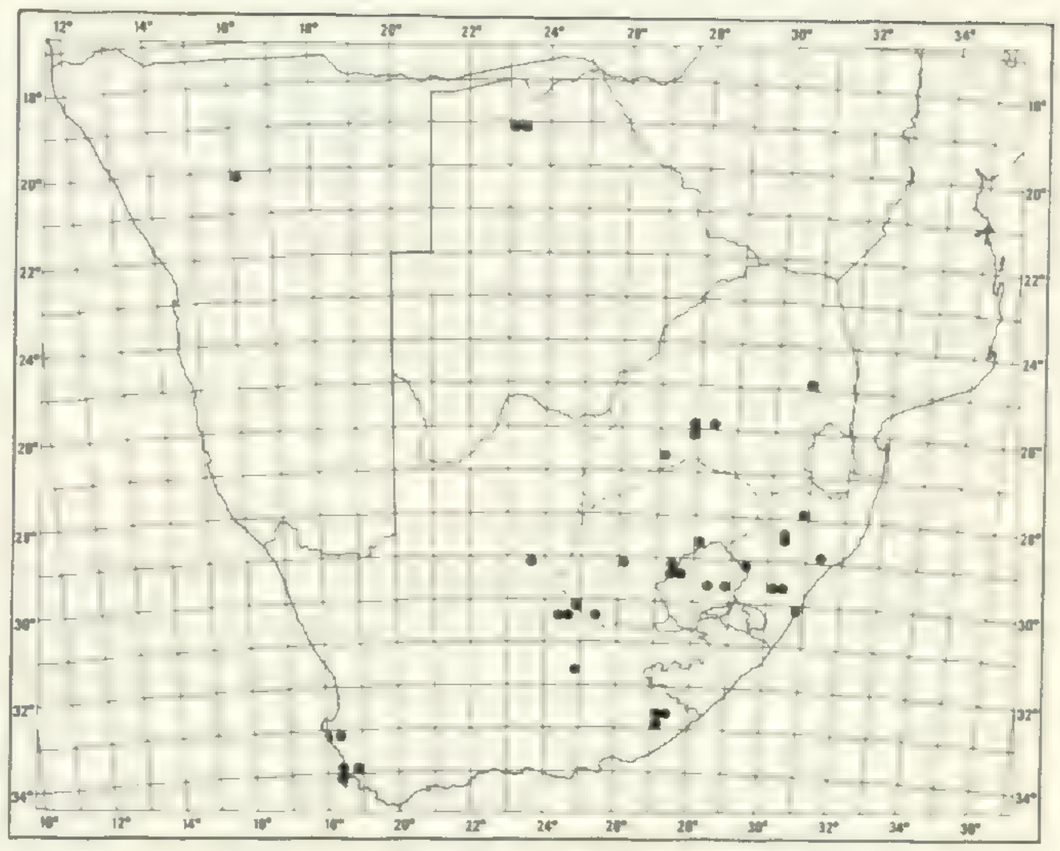
Didymodon perrevolutus P. Varde in Revue bryol. lichen. 27: 4 (1958). Type: Cape, Partridge Point, Cape Peninsula, *Arnell* 1188 (PC, holo.!).

Plants small to medium, in dense cushions, light green above, light brown below; terricolous or saxicolous. *Stems* 10–50 mm tall, frequently branched, especially in taller plants; in section round, central strand small, inner cortical cells large, thin-walled, outer cortical cells in 2–3 rows, smaller, incrassate, yellowish, outermost row substereids. *Leaves* appressed to slightly contorted dry, patent wet, shape extremely variable on same plant, ovate-acuminate to lanceolate or ligulate, 1,0–1,8 mm long; apex acute to broadly rounded; margins entire, reflexed to recurved below, plane to reflexed above. *Costa* percurrent to ending 10 cells below rounded apices, ventral and dorsal superficial cells quadrate to short-rectangular, incrassate, smooth; in section round, weakly differentiated, guide cells 2, ventral cells in 1–2 layers, incrassate, dorsal stereid band 1–2 rows thick, frequently cells substereids only, dorsal surface cells larger, similar to ventral cells, incrassate. *Upper laminal cells* quadrate to rounded-quadrate, incrassate, frequently with thickened corners in upper leaf, some cells with low, blunt papillae frequently obvious only in leaf sections; basal cells rectangular to short-rectangular, thin-walled, smooth.

Perichaetia terminal, becoming lateral through innovation, leaves ligulate, 1,5 mm long; apex obtuse to broadly rounded; leaf cells occasionally somewhat larger than vegetative leaf cells. *Seta* erect, 7–8 mm long, reddish; capsule short-cylindrical, 1,5 mm long, reddish to yellowish red; peristome absent; operculum rostrate, 0,4 mm long; spores round, 12–15 μm, weakly granulate. Fig. 68: 11–19.

Didymodon ceratodonteus is presently known from Zimbabwe, South West Africa/Namibia, Botswana, the central, eastern and southern Transvaal, Orange Free State, Lesotho, Zululand, Natal and the eastern, central and southwestern Cape. Map 89.

Vouchers: *Cholnoky* 768; *Retief* 366a.



MAP 89.— ● **Didymodon ceratodonteus**

Variation in size, leaf shape and rounding of the leaf apex account for the synonomy accompanying this species. Although many of the plants appear distinct macroscopically, the costal anatomy and cell size, shape and patterns are very consistent. In addition, a careful examination will clearly demonstrate the variation expressed by the leaves and leaf apices of most plants.

2. **Didymodon xanthocarpus** (*C. Müll.*) *Magill* in Mem. bot. Surv. S. Afr. 43: 5 (1979). Type: Cape, Swartkop River, *Ecklon* s.n. (BM!; H-SOL!).

Barbula xanthocarpa C. Müll. in Linnaea 17: 581 (1843).

Didymodon knysnae Rehm. ex Sim, Bryo. S. Afr. 248 (1926). Type: Cape, Knysna, *Rehmann* 83 (PRE, holo.!).

Plants medium-sized, forming cushions, yellowish green to reddish or dark green above, reddish below, frequently glossy; terricolous. *Stems* 10–20 mm tall, frequently branched above; in section round, central strand present, generally large, inner cortical cells large, incrassate, reddish or yellowish, outer cortical cells in 2–3 rows, stereids, red. *Leaves* contorted or rarely twisted around stem dry, widespreading wet; lanceolate to oval-acuminate, 2,0–3,5 mm long, keeled, rarely bistratose above; apex acute, mucronate; margins entire, revolute throughout. *Costa* strong, short-excurrent, ventral superficial cells rounded-quadrate, incrassate, smooth, dorsal superficial cells rectangular, incrassate, smooth; in section round, semicircular or oval, guide cells 4–6, ventral cells

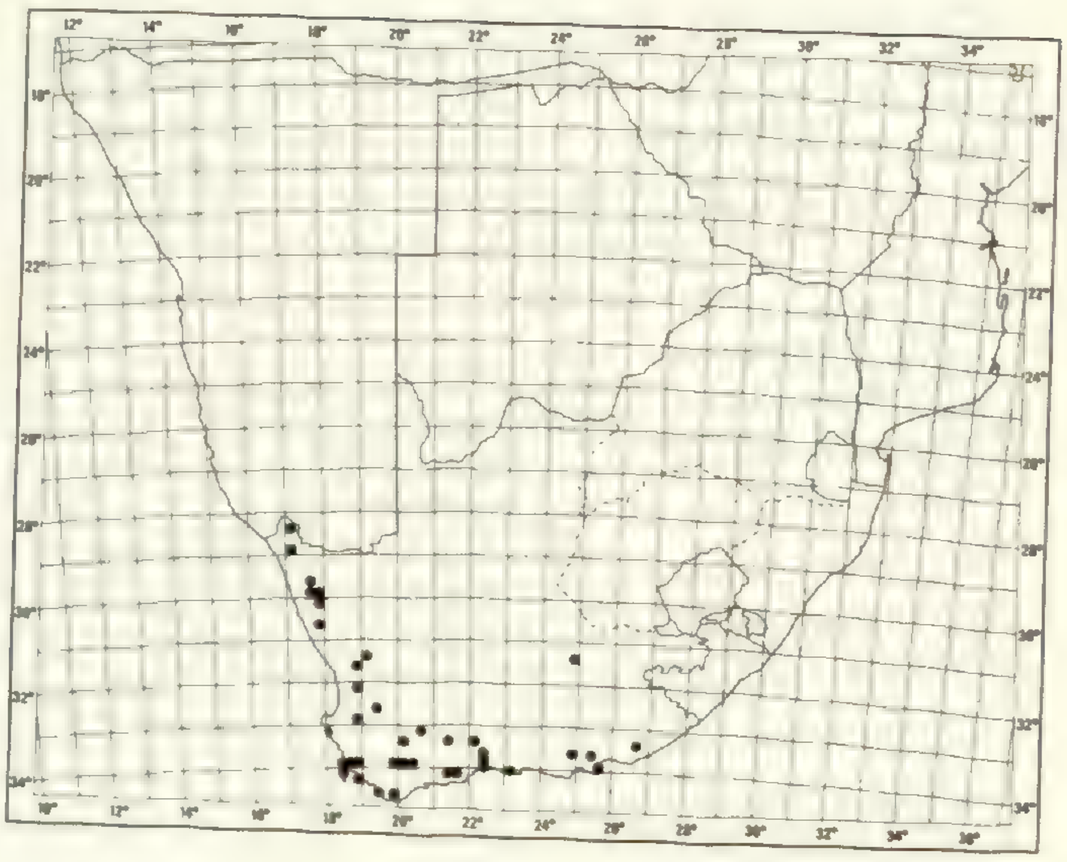
in 2–3 layers, similar to guide cells or frequently incrassate, ventral surface cells incrassate, mammillose or papillose, dorsal stereid band strong, 4–5 cells thick, reddish, dorsal surface cells larger, outer walls more strongly thickened. *Upper laminal cells* small, rounded-quadrate, incrassate, bulging or some cells mammillose; basal cells elongate, thin-walled, smooth.

Dioicous. Perichaetia terminal, leaves oblong, 2,0–2,5 mm long; apex irregularly notched; laminal cells irregularly shaped, triangular to rectangular, incrassate, smooth. *Seta* erect, 8–20 mm long, reddish yellow to dark red; capsule cylindrical to oblong-elliptical, 1,5–2,5 mm long, constricted at mouth; peristome weakly twisted, teeth linear, 0,8 mm long, finely papillose, yellowish red; operculum rostrate, 1,5 mm long; calyptra cucullate; spores round, 12,5–15,0 μm, granulate to smooth. Fig. 68: 1–10.

Known only from Southern Africa, *D. xanthocarpus* is found in shrublands of the Cape Province. Map 90.

Vouchers: *Claassen* 255; *Esterhuysen* 20148; *Magill* 5852; *Schelpe* 7807.

The lanceolate leaves with revolute margins and mammillose leaf cells will help to identify this species. The anatomy of the costa, with ventral cells in several rows, large and little thickened, is also distinctive.



MAP 90.— ● **Didymodon xanthocarpus**

A few specimens with bistratose leaves have been collected from the semi-arid regions of the western Cape. The bistratose leaves, frequently encountered in Pottiaceae, are seen as an adaptation to the dry habitat. The specimens conform in all other characters to the unistratose-leaved plants. Another modification observed in a few collections, was the presence of several weak papillae on the leaf cells. These plants generally do not have the strongly thickened mammillose leaf cells. It is possible that the bulging thickenings may obscure the fine papillae in most specimens.

4. BARBULA

Barbula *Hedw.*, Spec. Musc. 115 (1801); Saito in J. Hattori bot. Lab. 39: 481 (1975). Type species: *B. unguiculata* Hedw.

Trichostomum section *Hydrogonium* C. Müll. in Linnaea 40: 297 (1876). *Hydrogonium* (C. Müll.) Jaeg., Adumbratio 2: 669 (1880). Lectotype species: *H. ehrenbergii* (Lor.) Jaeg., vide Saito in J. Hattori bot. Lab. 38: 492 (1975).

Semibarbula Herz. ex Hilp. in Beih. bot. Zbl. 50: 626 (1933). Type species: *S. indica* (Brid.) Hilp.

Plants small to medium, in loose tufts or cushions, yellow-green to dark green; terricolous or saxicolous, infrequently aquatic. *Stems* erect, flaccid if aquatic, sparsely branched; in section round, central strand present, sometimes weak; axillary hairs 4–10 cells long, hyaline throughout. *Leaves* contorted or spirally twisted dry, spreading wet, plane or rugose; lanceolate to ligulate or ovate-ligulate; apex acute to obtuse; margins plane to spirally revolute, entire, generally papillose. *Costa* ending below apex to long-excurrent, ventral superficial cells rectangular to elongate, dorsal superficial cells rectangular, smooth, prorate or papillose; in section with dorsal and ventral stereid bands at least in lower leaf. *Laminal cells* quadrate to hexagonal, papillose to nearly smooth; marginal cells sometimes differentiated; basal cells weakly to strongly differentiated, elongate, smooth or papillose. *Gemmae* axillary or on rhizoids, multicellular, obovoid.

Dioicous. Perichaetia terminal; leaves larger, generally with sheathing base. *Seta* erect; capsule cylindrical; peristome teeth linear above short basal membrane, twisted; operculum conical; calyptra cucullate; spores round, smooth to papillose.

The genus *Barbula*, including *Semibarbula* and *Hydrogonium*, comprises c. 300 species and is the largest genus in the family. The genus is well represented in temperate regions of both hemispheres and is found on all continents, including Antarctica. The major concentration of species is found in western North and South America.

1 Costa smooth dorsally:
  2 Leaf margins plane in upper leaf:
    3 Leaves rugose; costa mucronate to aristate ..... 8. *B. eubryum*
    3 Leaves smooth; costa ending in or below apex ..... 9. *B. afrofontana*
  2 Leaf margins revolute to spirally revolute in upper leaf:
    4 Costa long-excurrent as a smooth, yellow awn ..... 1. *B. crinita*
    4 Costa mucronate to aristate:
      5 Leaves ligulate to lanceolate; marginal cells surrounded by spiralling lamina differentiated into specialized photosynthetic region ..... 2. *B. acutata*
      5 Leaves ovate-acuminate; marginal cells undifferentiated ..... 3. *B. hornschuchiana*
1 Costa scabrous or papillose dorsally:
  6 Basal leaf cells strongly differentiated, long-rectangular, yellowish, seriate papillose at junction with upper laminal cells:
    7 Leaves lanceolate to ligulate, 2–3 mm long; seta to 50 mm long, operculum very long ..... 4. *B. calycina*
    7 Leaves ligulate above obovate base, 1,5–2,5 mm long; seta to 15 mm long, operculum short ..... 5. *B. microcalycina*
  6 Basal leaf cells short-rectangular, smooth:
    8 Costa mucronate, dorsal superficial cells prorate ..... 6. *B. indica*
    8 Costa ending below apex, dorsal superficial cells seriate papillose ..... 7. *B. rehmannii*

1. **Barbula crinita** *Schultz* in Nova Acta Acad. Leop. Carol. 11: 226 (1823). Type: Java, *Dickson* s.n.

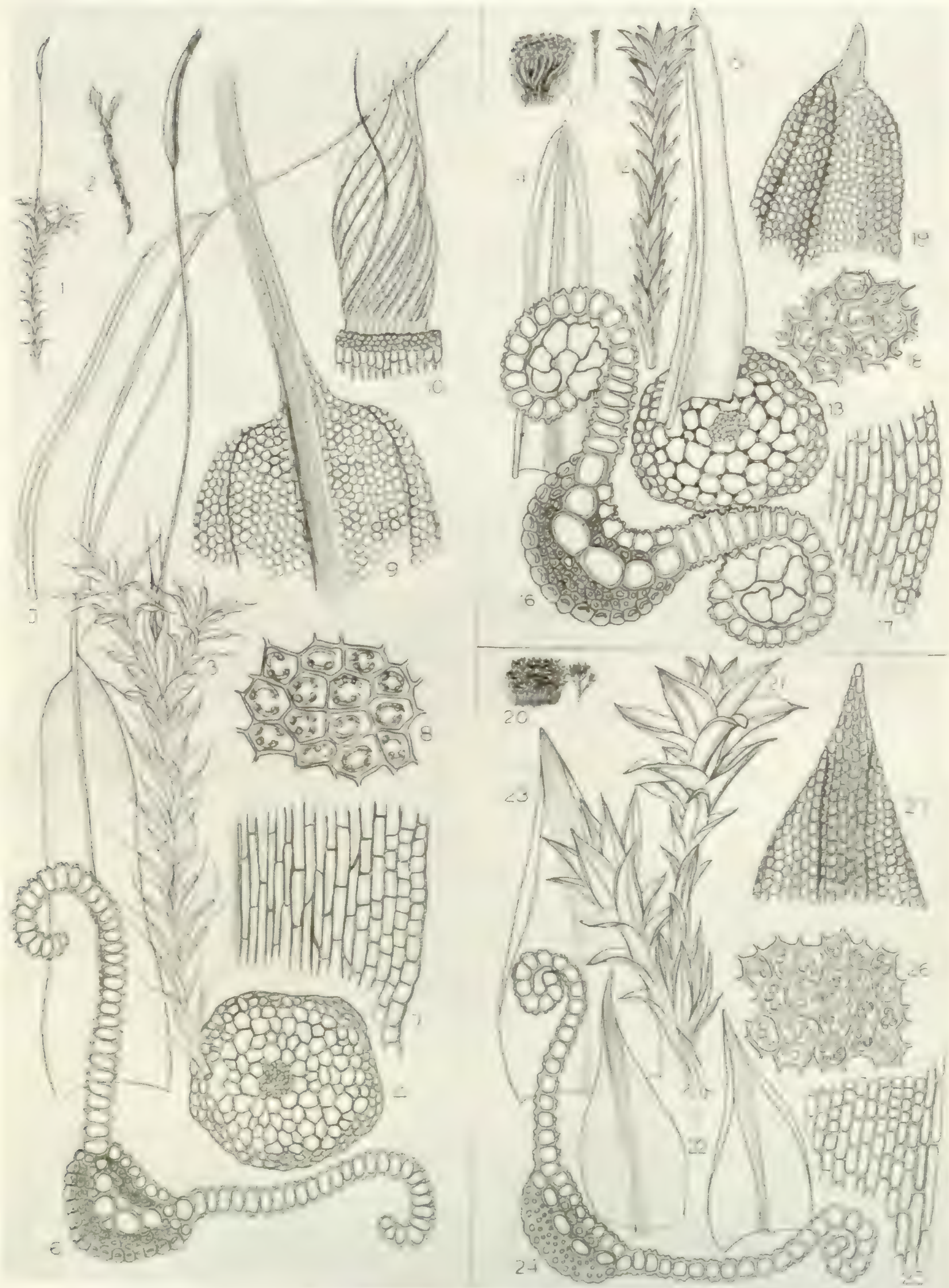
Tortula pilifera Hook., Musc. Exot. 1: 12 (1818); Sim, Bryo. S. Afr. 228 (1926). *Barbula pilifera* (Hook.) Brid., Bryo. Univ. 1: 572 (1826), hom. illeg.; Broth. in Natürl. PflFam. 10: 280 (1924); Weber in Lindbergia 1: 214 (1972).

Tortula pilifera Hook. var. *longifolia* Sim, Bryo. S. Afr. 229 (1926). Type: Cape, King William's Town, *Sim* 7323 (PRE, holo.!).

Barbula torquescens Schimp. ex C. Müll. in Bot. Ztg 16: 163 (1858); Broth. in Natürl. PflFam. 10: 280 (1924). Type: Cape, Groenkloof, *Breutel* s.n. (BM!).

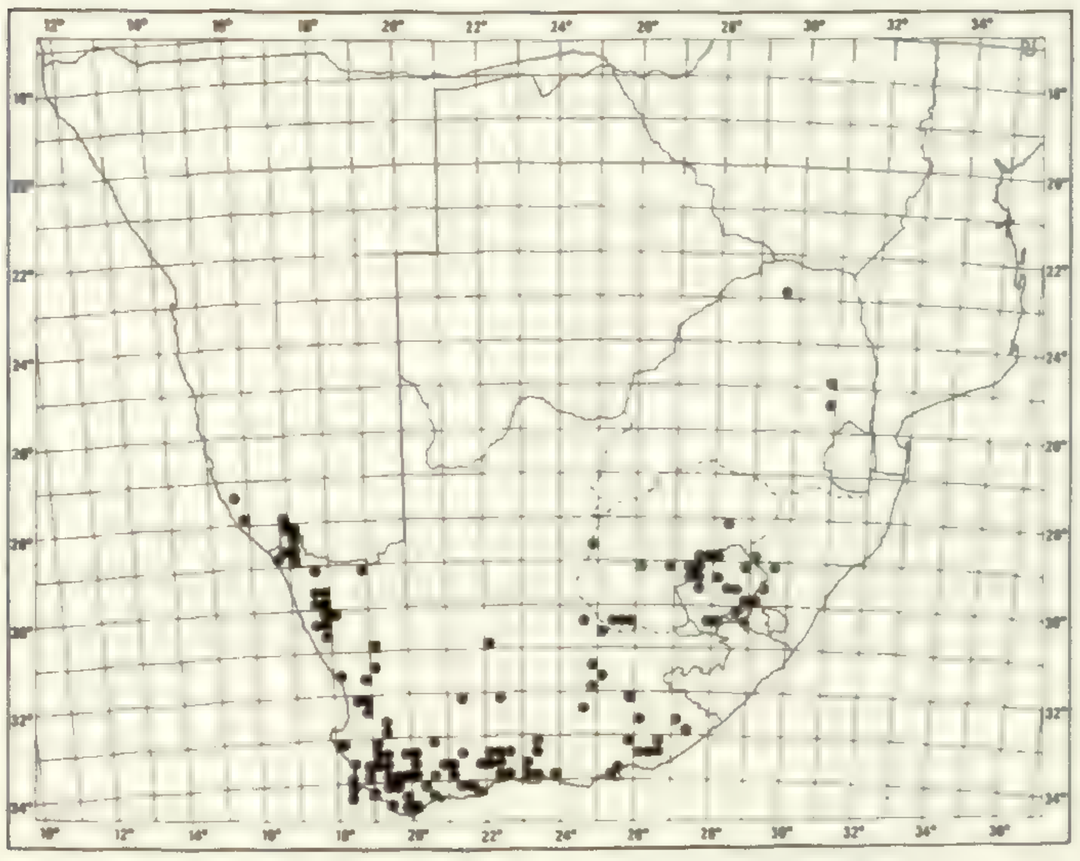
Plants medium-sized, in loose tufts, light green to yellow-green; terricolous or saxicolous. *Stem* to 35 mm high, infrequently branched; in section round, central strand small, cortical cells lax becoming incrassate near margin, 1–3 marginal rows smaller, substereids. *Leaves* contorted to spirally twisted dry, erect- to widespreading wet; lanceolate to linear above ovate base, 2,0–4,5 mm long; apex broadly acute to obtuse, frequently asymmetrical; margins recurved from base to apex, entire. *Costa* long-excurrent as yellowish, smooth to weakly denticulate awn, 1–2 mm long, ventral superficial cells quadrate, papillose, dorsal superficial cells elongate, strongly incrassate, smooth; in section reniform, guide cells 4, ventral stereid band small, over central guides, 2–3 cells thick, infrequently cells substereids, ventral surface cells thin-walled, papillose, dorsal stereid band large, 4–6 cells thick, dorsal surface cells unevenly thickened, lumen crescent-shaped. *Upper laminal cells* hexagonal to quadrate, with 2–4 large, C-shaped papillae over lumen; basal leaf cells short- to long-rectangular, smooth.

Dioicous. Perichaetial leaves sheathing seta, oblong to elliptical, 4–5 mm long; apex acute; margins plane, entire, laminal cells elongate, rectangular to polygonal; basal cells long-rectangular. *Seta* erect, to 20 mm long, reddish yellow; capsule cylindrical, to 4 mm long, reddish brown; peristome yellowish, teeth filiform, papillose, spirally twisted, basal membrane short, 1–3



cells above mouth; operculum conical, 1,5 mm long; spores round, 10–12 μm, finely papillose. Fig. 69: 1–10.

Barbula crinita is a rather common moss in dry shrublands of Southern Africa, South America, Australia and New Zealand. The species is common throughout semi-arid and arid regions of the Cape and southern South West Africa/Namibia, but is also found in the Orange Free State, Lesotho, Natal and Transkei. A few specimens are known from the eastern and northern Transvaal. Map 91.



MAP 91.— ● **Barbula crinita**

Vouchers: *Boucher* PRE-CH12771; *Esterhuysen* 20585; *Garside* 6614; *Hardy* 4219a; *Lavranos* 15554c; *Magill* 4655, 5817, 6049; *Schelpe* 7795; *Van Rooy* 37.

The general habit of this species and the long-excurrent costa, indicate a relationship to *Tortula*. The presence of a ventral stereid band in the costa clearly indicates that the species is a *Barbula*.

2. **Barbula acutata** *C. Müll.* in Hedwigia 38: 109 (1899); Broth. in Natürl. PflFam. 10: 280 (1924). Type: Transvaal, Spitzkop, near Lydenburg, *Wilms* s.n., 1887 (G, holo.!).

Plants medium-sized, in loose cushions, green; terricolous. *Stems* 8–15 mm high; in section with large central strand, inner cortical cells in 3–4 rows, lax, outer cortical cells in 1–2 rows, smaller, incrassate, reddish. *Leaves* appressed, spirally twisted around stem dry, erect-spreading wet; broadly lanceolate to ligulate, 1,0–1,5 mm long; apex obtuse to broadly acute, mucronate; margins spirally revolute, entire, marginal cells differentiated into specialized photosynthetic region; in section juxtacostal laminal cells papillose on dorsal and ventral surfaces, cells decreasing in height toward revolute margins; cells smooth dorsally in revolute portion, 4–6 marginal cells enclosed by spiralling leaf, enlarged, thin-walled. *Costa* short-excurrent to percurrent, strong to apex, 60–70 μm wide at apex, ventral superficial cells quadrate, papillose, dorsal superficial cells elongate-rectangular, incrassate, smooth; in section reniform to flattened, guide cells 4–6, large, incrassate, ventral stereid band small, 1–4 cells over central guide cells, ventral surface cells larger, thin-walled, papillose, dorsal stereid band strong, 5–6 cells thick, dorsal surface cells with strongly thickened outer walls, lumen lunate. *Upper laminal cells* quadrate to short-rectangular, with 4–6 low, O- or C-shaped papillae over lumen; marginal cells differentiated, enlarged, smooth; basal cells rectangular, smooth.

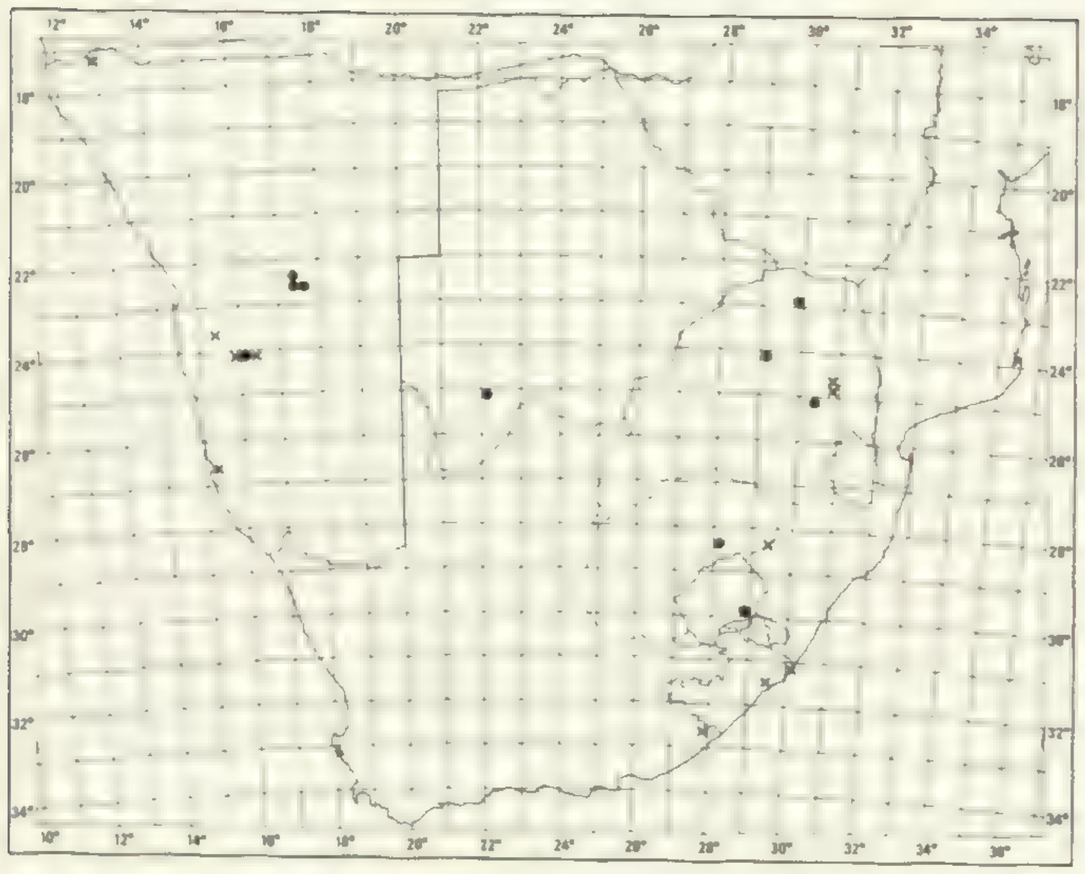
Sporophyte not known. Fig. 69: 11–19.

Barbula acutata is found only in Southern Africa. The species is associated with high, semi-arid grasslands of central South West Africa/Namibia, Botswana, the northern, eastern and central Transvaal, Orange Free State and Lesotho. Map 92.

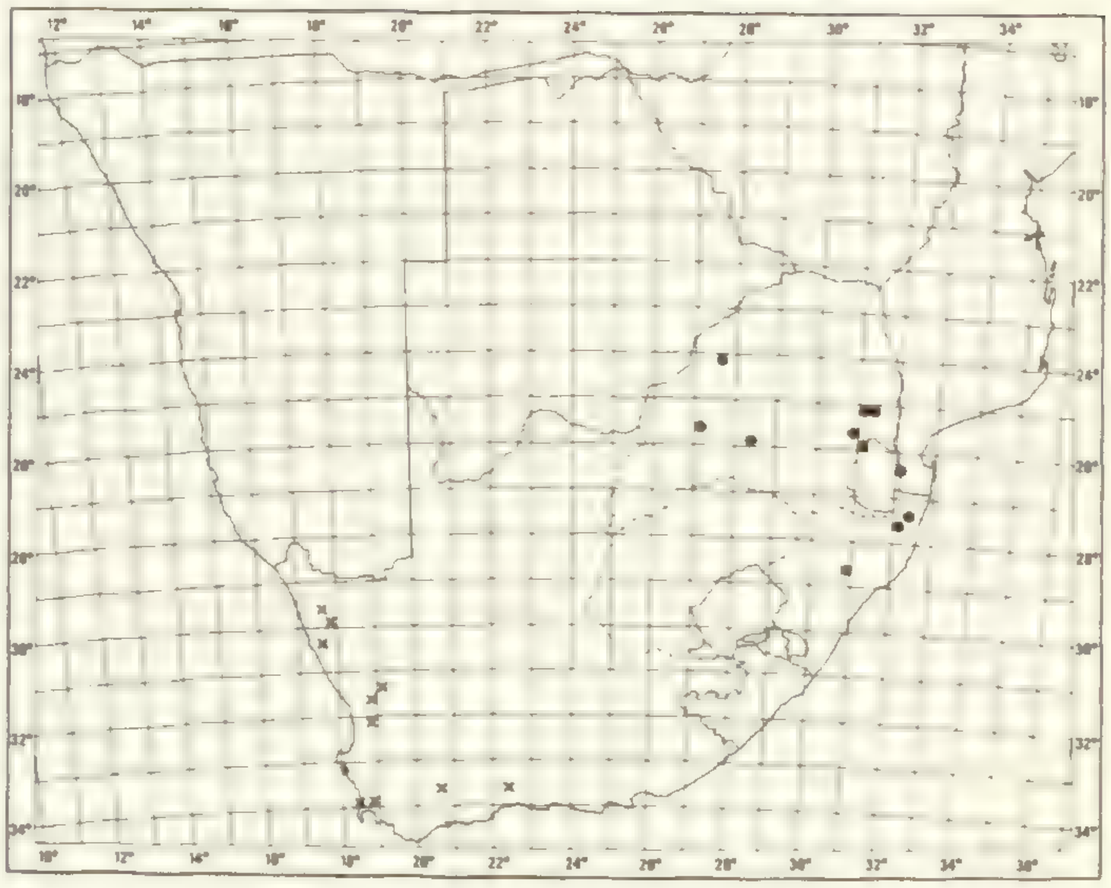
Vouchers: *Magill* 3637, 4256; *Phelan et al.* 72a; *Schelpe* PRE-CH12750; *Van Rooy* 329.

The highly specialized marginal cells and presence of the ventral stereid band in the costa characterize this species. These features also place the species within Zander's (1979) concept of *Pseudocrossidium* Williams. The presence of specialized marginal cells in *Tortula porphyreoneura* suggests that modification

FIG. 69.—**Barbula crinita** (1–10): **1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, ×5; **4.** stem in cross section, ×200; **5.** leaves, ×20; **6.** leaf in cross section, ×170; **7.** cells at leaf base (right side), ×170; **8.** upper laminal cells, ×640; **9.** leaf apex, ×170; **10.** capsule mouth with peristome, ×25. **B. acutata** (11–19): **11.** habit, ×1; **12.** habit, ×5; **13.** stem in cross section, ×200; **14–15.** leaves, ×40; **16.** leaf in cross section, ×300; **17.** basal leaf cells (right side), ×170; **18.** upper laminal cells, ×640; **19.** leaf apex, ×170. **B. hornschuchiana** (20–27): **20.** habit, ×1; **21.** habit, ×10; **22.** leaves, ×40; **23.** upper leaf, ×40; **24.** leaf in cross section, ×200; **25.** basal cells near costa (left side), ×170; **26.** upper laminal cells, ×640; **27.** leaf apex, ×170. (1–10, *Sim* 9598; 11–19, *Magill* 4266; 20–27, *Schelpe* 7802a).



MAP 92.— ● **Barbula acutata**
× **Barbula afrofontana**



MAP 93.— ● **Barbula eubryum**
× **Barbula hornschuchiana**

of marginal or costal cells into differentiated photosynthetic tissues is an adaptation to harsh environments, expressed through convergent evolution by several genera in the Pottiaceae, e.g. *Tortula*, *Barbula*, *Crossidium*, *Pterygoneurum*, *Aloina* and *Acaulon*. Because of the apparently intergeneric configuration of *Pseudocrossidium*, the species referrable there, have been placed under various genera until further studies can resolve the problems.

3. **Barbula hornschuchiana** *Schultz* in Flora, Jena 5 (Syll.): 35 (1822); Broth. in Natürl. PflFam. 10: 278 (1924); Sim, Bryo. S. Afr. 239 (1926); Smith, Moss Fl. Brit. Irel. 252 (1978). Type: Europe.

Plants small, caespitose, dark green to reddish brown; terricolous. *Stems* 2–6 mm tall, infrequently branched; in section with small central strand, inner cortical cells lax, outer cortical cells in 1–2 rows, stereids, dark red. *Leaves* spirally twisted around stem dry, erect-spreading wet, ovate-acuminate to triangular, 0,8–1,5 mm long; apex acuminate, apiculate to cuspidate; margins spirally revolute, frequently involving complete upper lamina. *Costa* short-excurrent, broad, ventral superficial cells quadrate to rounded, sparsely papillose, dorsal superficial cells short-rectangular, smooth; in section flattened to reniform, guide cells 4–6, ventral stereid band in 1–2 rows, cells infrequently substereids or only incrassate, ventral surface cells larger, incrassate, papillose, dorsal stereid band 4–5 cells thick, dorsal surface cells frequently substereids, smooth. *Upper laminal cells* rounded-quadrate, incrassate, sharply mammillose or rarely with 4–6 low, fine, C-shaped papillae over lumen; basal cells larger, quadrate to rectangular, smooth.

Sporophyte not known in Africa. Middle Eastern and European specimens have: perichaetial leaves longer; seta short, orange; capsule narrowly elliptical, weakly curved, dark brown; operculum long-rostrate; spores 8–10 μm. Fig. 69: 20–27.

Barbula hornschuchiana is reported from northern and Southern Africa, Europe and the Middle East. In Southern Africa, the species has been collected in the semi-arid shrublands of the southern and western Cape. Map 93.

Vouchers: *Magill* 6080; *Schelpe* 7732.

The species is recognized by its ovate-acuminate leaves with broad costa and strongly revolute margins. The species was recently transferred to *Pseudocrossidium* by Zander (1979). The Southern African specimens do not show specialization of marginal or costal tissues characteristic of the genus.

4. **Barbula calycina** *Schwaegr.*, Sp. Musc. Suppl. 2: 63 (1823); Broth. in Natürl. PflFam. 10: 280 (1924). Type: Australia, *La Billardiere* s.n.

Tortella calycina (Schwaegr.) Dix. in N. Zeal. Inst. Bull. 3: 124 (1924); Scott & Stone, Moss. S. Aust. 200 (1976).

Tortula flexuosa Hook., Musci Exot. 2: 125 (1819), hom. illeg., non Brid. (1806). *Barbula flexuosa* (Hook.)

Schultz in Nova Acta Acad. Leop. Carol. 11: 208 (1823). *Barbula hookeri* Steud. in Nom. Bot. 2: 72 (1824). Type: Cape, *Menzies* s.n., 1791 (BM, holo.!).

Plants medium-sized, loosely caespitose, yellow-green above, reddish brown below; terricolous. *Stems* 10–20 mm tall, branching by subperichaetial innovations, occasionally with white tomentum below; in section subround, central strand present, small, inner cortical cells large, thin-walled, outer cortical cells in 1–2 rows, stereids, reddish. *Leaves* larger above, incurved dry, erect-spreading to widespreading above erect base wet; lanceolate to ovate-ligulate, 2–3 mm long; apex acute to obtuse, mucronate; base oblong to weakly obovate, appressed to stem; margins plane, entire. *Costa* short-excurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells quadrate to short-rectangular, incrassate, papillose; in section semicircular to reniform, guide cells 6, ventral stereid band strong, 2–4 cells thick, ventral surface cells larger, thin-walled, papillose, dorsal stereid band strong, 2–4 cells thick, dorsal surface cells incrassate, papillose. *Upper laminal cells* subhexagonal to quadrate, weakly incrassate, with 4–6 large, simple, well-spaced papillae over lumen, not obscuring cells; upper basal cells rectangular to linear, yellowish, seriate papillose, extending down along costa, occasionally to base, lower basal cells oblong-hexagonal to rectangular, hyaline to yellowish, smooth, thin-walled.

Dioicous. Perichaetial leaves highly differentiated, lower leaves abruptly short-subulate above elliptical, sheathing base, cells of subula papillose, upper leaves spirally sheathing seta, 3–5 mm long, irregularly serrate at apex; leaf cells fusiform, sinuate. *Seta* 20–50 mm long, yellowish to reddish; capsule cylindrical, 2,5 mm long, with very short neck, yellowish red; peristome 1,6–1,8 mm long, cleft to near base, teeth linear, reddish, strongly papillose, twisted 1½ turns counter-clockwise, united below into short basal membrane, 50 μm high, papillose; operculum long-conic, 2,3 mm long, cells twisted counter-clockwise; calyptra long-cucullate; spores round, 8–10 μm, smooth. Fig. 70: 1–9.

Barbula calycina is common in flat, sandy areas of Australia, New Zealand, southeast Asia and South America. The single South African collection was reported from the fynbos biome of the south-western Cape. Map 94.

Voucher: *Menzies* s.n., 1791 (BM!).

The Menzies collection is identical to plants examined from Australia. The species is rather common in parts of Australia (Scott, pers. comm.) but was collected only once from South Africa. Since Menzies's travels included both South Africa and Australia in 1791, an error in labelling may have occurred. The inclusion of *B. calycina* in the Flora is provisional until additional material is collected.

Vegetatively *B. calycina* is closely related to *B. microcalycina*, although the two species differ in leaf shape, as well as several sporophytic characters.

5. **Barbula microcalycina** *Magill,* sp. nov., *habitu et cellulis foliorum basilibus distinctis singularibusque* B. calycina *Schwaegr. similis, sed forma foliorum, seta breviore, peristomio brevi recto, operculo brevissimo et sporibus majoribus differt.*

Type: Natal, Cathedral Peak, Upper Indumeni Forest, *Magill* 5706 (PRE, holo.; C; H; MO; NY).

Plants small to medium, loosely caespitose, yellow-green to light green, glaucous-green dry, brownish below; terricolous or saxicolous. *Stems* 8–20 mm high, thin, branching by subperichaetial innovations; in section round, central strand present, small, frequently collapsed, inner cortical cells large, thickened, outer cortical cells in 1–3 rows, stereids, reddish. *Leaves* about equal throughout, incurved dry, widely spreading to squarrose above clasping base wet, weakly keeled; broadly lanceolate to ligulate above obovate base, 1,5–2,5 mm long; apex broadly acute to obtuse, mucronate; base sheathing; margins plane, entire. *Costa* short-excurrent, strong, ventral superficial cells quadrate to short-rectangular, papillose, dorsal superficial cells quadrate to short-rectangular, incrassate, papillose; in section subround, guide cells 4, ventral stereid band strong, in rounded group, 4 cells thick, ventral surface cells similar to laminal cells, papillose, dorsal stereid band strong, 3–4 cells thick, dorsal surface cells incrassate, papillose. *Upper laminal cells* rounded, quadrate, incrassate, papillae 4–6 over cell, low, simple or sometimes C-shaped, obscuring cells; basal cells highly differentiated,

upper basal cells rectangular or fusiform, seriate papillose, lower basalcells rectangular, hyaline, thin-walled, smooth.

Dioicous. Perichaetia terminal, leaves differentiated, 1,2–1,5 mm long; lanceolate to acuminate above long-oblong, sheathing base, papillose above. *Seta* 10–15 mm long, yellow; capsule cylindrical, 1,8 mm long, with very short neck, yellowish red; peristome present, teeth irregularly cleft to base, 75 μm long, straight, papillose, reddish yellow; operculum short-conic, 0,5–1,0 mm long, cells weakly twisted counter-clockwise; calyptra cucullate, to 3,5 mm long, twisted below, spores round, 12–15 μm, smooth. Fig. 70: 10–19.

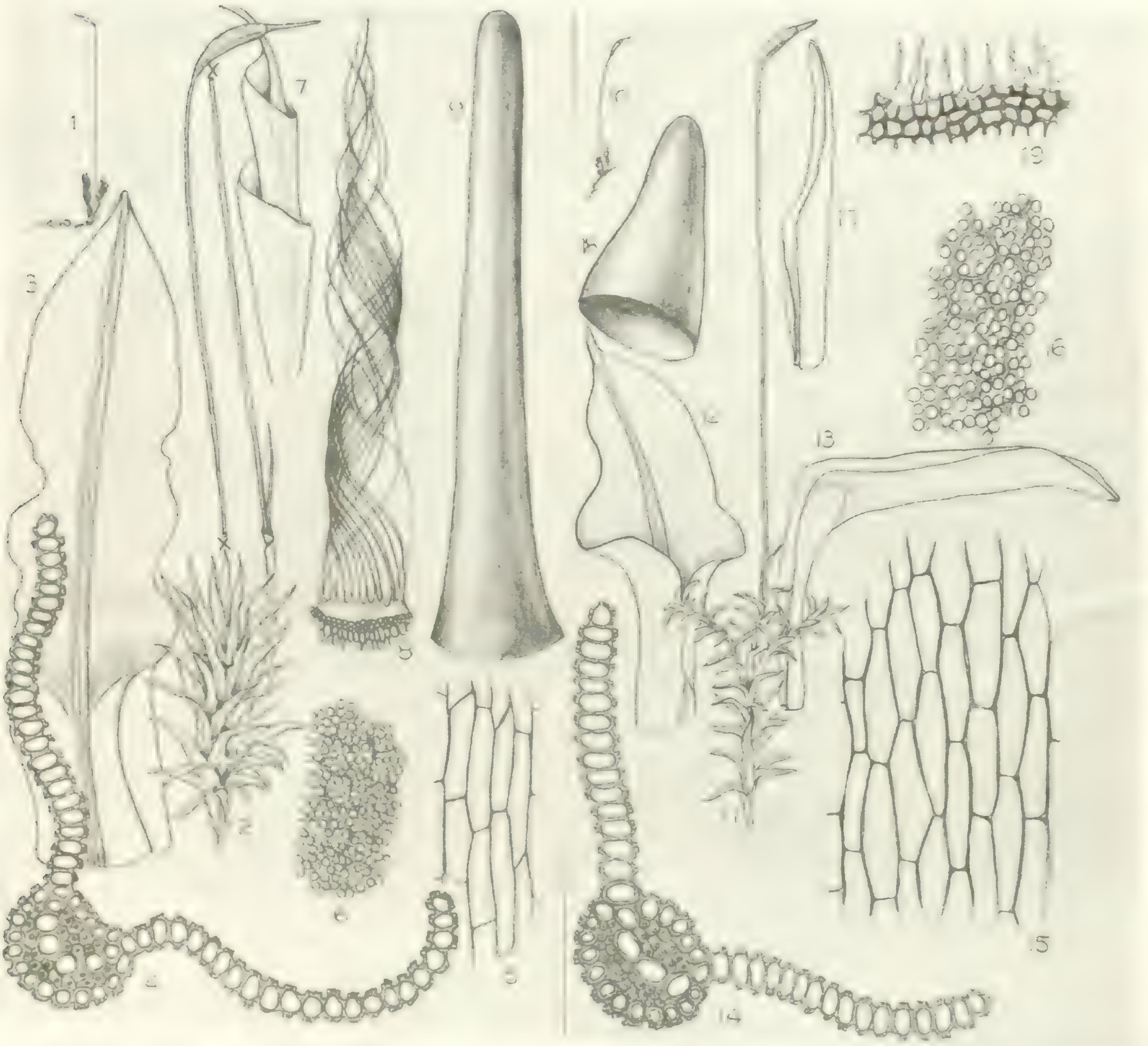
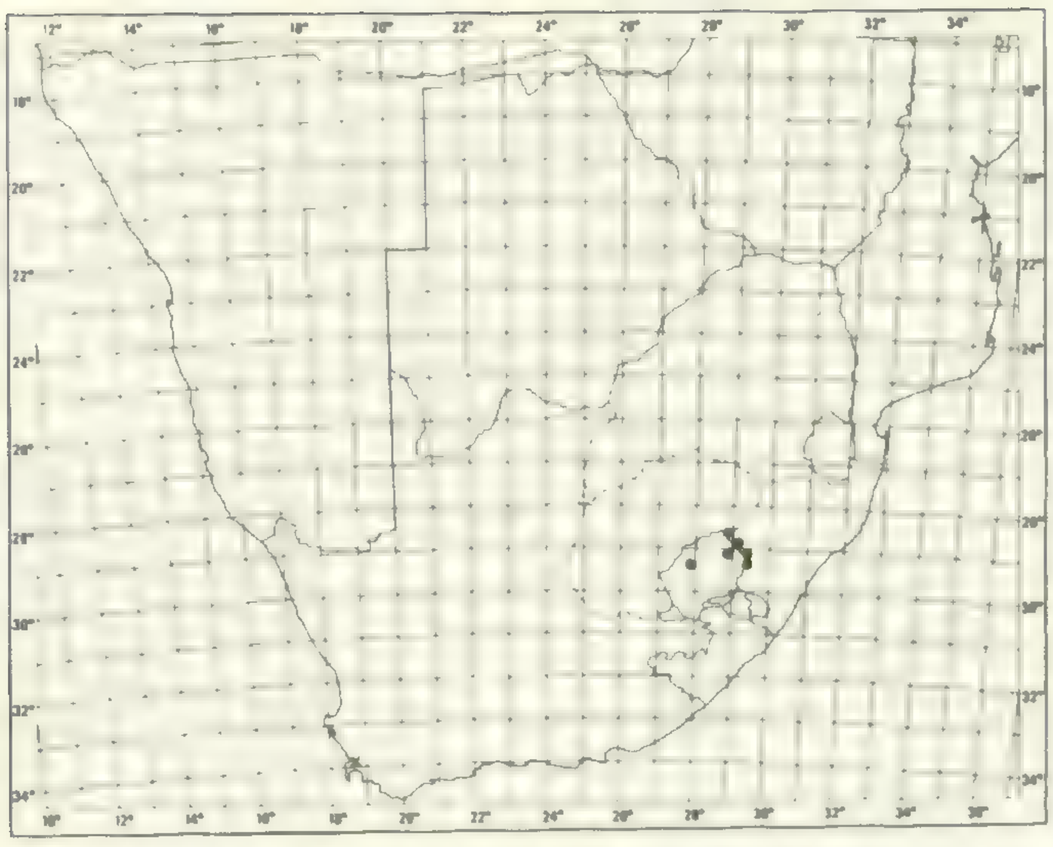


FIG. 70.—**Barbula calycina** (1–9): **1.** habit, ×1; **2.** habit, ×5; **3.** leaf, ×40; **4.** leaf in cross section, ×170; **5.** basal leaf cells, ×170; **6.** upper laminal cells, ×435; **7.** perichaetial leaf, ×20; **8.** part od capsule mouth with peristome teeth, ×40; **9.** operculum, ×40. **B. microcalycina** (10–19): **10.** habit, ×1; **11.** habit, ×5; **12–13.** perichaetial leaf, ×20; **18.** operculum, ×40; **19.** part of capsule mouth with peristome teeth, ×40. (1–9, *Scott* 775; 10–19, *Smook* 1418).



MAP 94.— ● **Barbula microcalycina**
× **Barbula calycina**

Endemic to Southern Africa, *B. microcalycina* is presently known only from the subalpine grasslands of Lesotho and the Cathedral Peak and Giant's Castle areas of the Natal Drakensberg. Map 94.

Vouchers: *Magill* 4114, 5689, 5813; *Pienaar* 44; *Smook* 1118, 1418; *Van Rooy* 4.

This species is similar to *B. calycina*, but differs in the ligulate leaves with obovate, sheathing bases, shorter seta, short, straight peristome and much shorter operculum. It can be separated from other species by its highly differentiated basal leaf cells.

6. **Barbula indica** (*Hook.*) *Spreng.* in Steud., Nom. Bot. 2: 72 (1824); Saito in J. Hattori bot. Lab. 39: 488 (1975); Sim, Bryo. S. Afr. 236 (1926). Syntypes: India Orientalis, *Röttler* s.n.; Horti Botanici Calcuttae, Indiae Orientalis, *Wallich* s.n.

Tortula indica Hook., Musci Exot. 2: 135 (1819). *Semibarbula indica* (Hook.) Herz. ex Hilp. in Beih. bot. Zbl. 50: 626 (1933).

Trichostomum orientalis Web. in Arch., Syst. Naturgesch. 1: 129 (1804). *Barbula orientalis* (Web.) Broth. in Natürl. PflFam. 1: 403 (1902), hom. illeg., non *B. orientalis* Brid., Mant. Musc. 3: 93 (1819). *Semibarbula orientalis* (Web.) Wijk & Marg. in Taxon 8: 75 (1959). Type: Asia, India Orientalis, *Klein* s.n.

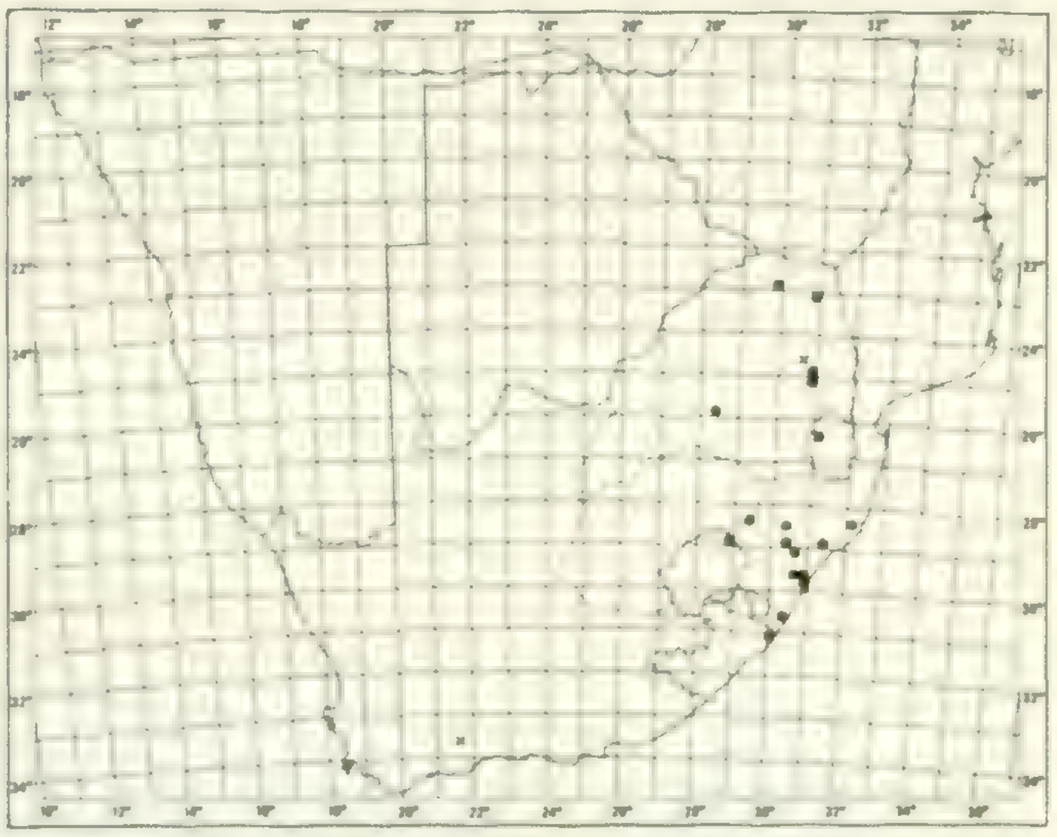
Hymenostomum opacum Wag. & Dix. in Trans. R. Soc. S. Afr. 4: 3 (1914). Type: Natal, Van Reenen, *Wager* s.n. (PRE, holo.!).

Barbula natalensis C. Müll. in Hedwigia 38: 106 (1899). Type: Natal, Port Natal (Durban), *Rehmann* s.n., vide Dixon in S. Afr. J. Sci. 18: 313 (1922).

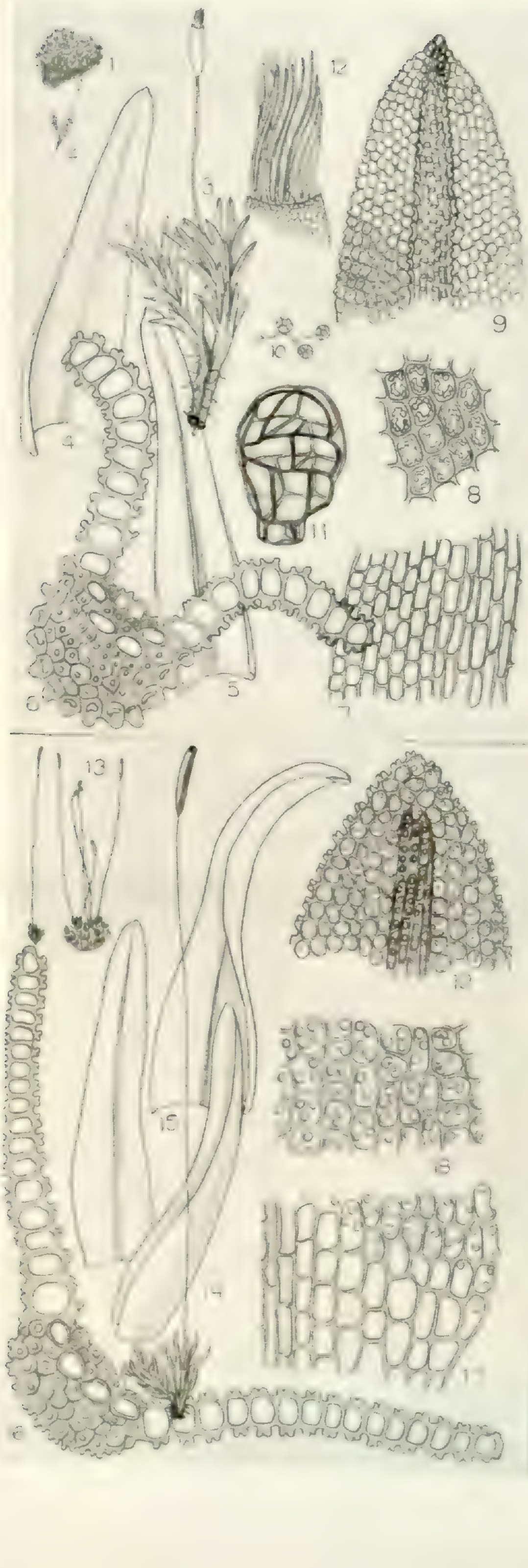
Plants small, loosely caespitose, light green; terricolous. *Stems* 2–8 mm tall, simple; in section round, central strand present, inner cortical cells lax, becoming smaller toward margin, incrassate, outer cortical cells in 1–2 rows, substereids, reddish brown. *Leaves* crisped dry, spreading wet; lanceolate to ovate-ligulate, 1,0–1,8 mm long; apex obtuse, apiculate; margins plane to infrequently recurved below, entire. *Costa* short-excurrent, ventral superficial cells rectangular, smooth, dorsal superficial cells rectangular, strongly prorate; in section subround, guide cells 2–4, ventral stereid band small, 1–2 cells thick, ventral surface cells substereids or only incrassate; dorsal stereid band large, 4–5 cells thick, dorsal surface cells substereids, outer walls strongly thickened, lumen frequently lunate. *Upper laminal cells* quadrate or some hexagonal, somewhat thickened, with 3–4 large, C-shaped papillae over lumen; basal cells oblong, elongate, hyaline, smooth. *Gemmae* axillary or on axillary rhizoids, multicellular, obovoid, 70–100 μm, brownish.

Dioicous. Perichaetia terminal; leaves to 2 mm long, weakly differentiated. *Seta* 4–6 mm long, yellowish; capsules short-cylindrical, 0,8–1,2 mm long, reddish yellow; peristome erect or weakly twisted, fragile, teeth linear, papillose, red-brown; operculum conical, 0,4–0,6 mm long; spores round, 10–14 μm, smooth. Fig. 71: 1–12.

Barbula indica occurs in Southern and central Africa, the Indian subcontinent, southern and south-east Asia and Japan. In Southern Africa the species grows on soil in grasslands of Transvaal, Lesotho, Natal and Transkei. Map 95.



MAP 95.— ● **Barbula indica**
× **Barbula rehmannii**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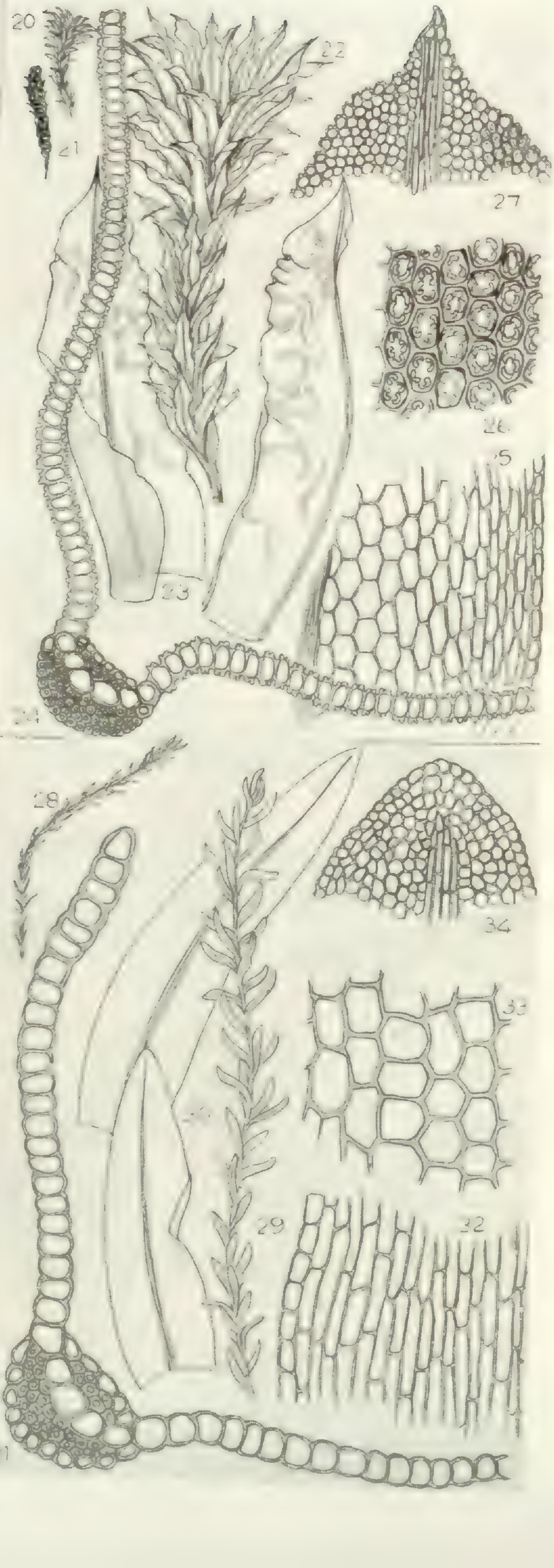
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Vouchers: *Cholnoky* 653; *Magill* 3615; *Sim* 10091; *Stirton* 6948.

The strongly prorate dorsal costal cells and numerous obovoid, multicellular gemmae characterize *B. indica*. Specimens are only infrequently collected with sporophytes.

7. **Barbula rehmannii** *C. Müll.* in Hedwigia 38: 106 (1899); Broth. in Natürl. PflFam. 10: 280 (1924). Type: Cape, Touws River, *Rehmann* 101 (PRE!).

Plants small, caespitose, yellow-green; terricolous. *Stems* 2–5 mm high, infrequently branched; in section round, central strand present, inner cortical cells lax, outer cortical cells in 1–2 rows, smaller, incrassate, red-brown. *Leaves* contorted dry, patent wet; oval-ligulate to lanceolate, 1,0–1,5 mm long; apex obtuse to obtusely acute; margins plane to reflexed in base, entire. *Costa* ending several cells below apex, ventral superficial cells rectangular, sparsely papillose, dorsal superficial cells long-rectangular, incrassate, seriate papillose; in section subreniform, guide cells 4, ventral stereid band 1–2 cells thick, ventral surface cells not differentiated, dorsal stereid band 3–4 cells thick, dorsal surface cells not differentiated. *Upper laminal cells* quadrate to subquadrate, incrassate, strongly papillose, papillae C-shaped, 4–5 per cell; basal cells larger, rectangular, papillose almost to base.

Dioicous. Perichaetia terminal; leaves from very broad sheathing base, abruptly narrow-acuminate, 1,0 mm long. *Seta* long, to 20 mm, red-brown; capsule cylindrical, 1,5–2,0 mm long, slightly curved, red-brown; peristome fragile, yellowish, only short basal membrane seen; other parts not seen. Fig. 71: 13–19.

Endemic to Southern Africa, *B. rehmannii* has been collected in fynbos of the southern and south-western Cape and grasslands of the eastern Transvaal. Map 95.

Voucher: *Magill* 3240.

Similar to *B. indica* in habit, *B. rehmannii* is identified by its subpercurrent costa, papillose dorsal costal cells and very long seta.

8. **Barbula eubryum** *C. Müll.* in Flora, Jena 62: 379 (1879). Type: Tropical East Africa, Ukamba Kitui, *Hildebrandt* s.n., 1877.

Tortula eubryum (C. Müll.) Broth. in Engler, Pflanzenw. Ost.-Afr. C: 69 (1916); Sim, Bryo. S. Afr. 228 (1926).

Plants medium-sized, forming loose tufts, yellow-green, blackish below; terricolous or saxicolous. *Stems* 10–15 mm tall, infrequently branched, tomentose below; in section round, central strand small or rarely absent in some plants, inner cortical cells large, outer cortical cells in 1–2 rows, smaller, incrassate, red-yellow. *Leaves* spirally twisted around stem dry, patent wet, rugose to rugulose, keeled; ligulate to broadly lanceolate, 3,5–4,0 mm long; apex obtuse to broadly acute, mucronate to apiculate; margins plane to reflexed below, entire. *Costa* short-excurrent, ventral superficial cells rectangular, thin-walled, smooth, dorsal superficial cells elongate, smooth, incrassate; in section reniform to subround, guide cells 3–4, ventral stereid band small, in one row over central guide cells, ventral surface cells incrassate, dorsal stereid band large, 4–5 cells thick, dorsal surface cells substereids. *Upper laminal cells* hexagonal to quadrate, papillose with 4–6 low papillae over lumen; basal leaf cells large, rectangular, smooth, becoming narrowly rectangular toward margin.

Sporophytes not seen on Southern African plants. *Setae* in Ugandan plants are 10–12 mm long and capsules cylindrical,

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FIG. 71.—**Barbula indica** (1–12): **1.** habit, ×1; **2.** habit, ×1; **3.** habit, ×5; **4–5.** leaves, ×30; **6.** leaf in cross section, ×435; **7.** basal leaf cells (left side), ×250; **8.** upper laminal cells, ×640; **9.** leaf apex, dorsal surface (papillae partly shown), ×250; **10.** rhizoid gemmae, ×40; **11.** axillary gemmae, ×300; **12.** capsule mouth with peristome, ×30. **B. rehmannii** (13–19): **13.** habit, ×1; **14.** habit, ×5; **15.** leaves, ×30; **16.** leaf in cross section, ×435; **17.** basal leaf cells (right side), ×250; **18.** upper laminal cells, ×640; **19.** leaf apex, ×250. **B. eubryum** (20–27): **20.** habit, wet, ×1; **21.** habit, dry, ×1; **22.** habit, ×5; **23.** leaves, ×15; **24.** leaf in cross section, ×190; **25.** cells at leaf base (right side), ×90; **26.** upper laminal cells, ×300; **27.** leaf apex (papillae not shown), ×90. **B. afrofontana** (28–34): **28.** habit, ×1; **29.** habit, ×2; **30.** leaves, ×20; **31.** leaf in cross section, ×320; **32.** basal leaf cells (left side), ×170; **33.** upper laminal cells, ×435; **34.** leaf apex, ×170. (1–3, *Stirton* 6958; 4–12, *Cholnoky* 447; 13–19, *Rehmann* 101; 20–27, *Magill* 3580; 28–34, *Rehmann* 82).

2,5–3,0 mm long. The Ugandan plants are frequently twice as tall as Southern African specimens. Fig. 71: 20–27.

Barbula eubryum is known from central and Southern Africa. In the south the species is found on soil or rock in grassland and woodland communities of central and eastern Transvaal, Swaziland, Zululand and Natal. Map 93.

Vouchers: *Harrison* 14; *Magill* 3571, 3580; *Van Vuuren* 1742.

The large plants with broad, rugose leaves are very distinctive and characterize the species. The size and habit of the plants suggest a relationship to *Tortula*, but the presence of a ventral stereid band in the costa indicates that the species is correctly placed in *Barbula*.

9. **Barbula afrofontana** (*C. Müll.*) *Broth.* in Natürl. PflFam. 10: 280 (1924); Sim, Bryo. S. Afr. 235 (1926). Type: Natal, Van Reenens Pass, *Rehmann* 82 (PRE!).

Trichostomum afrofontanum C. Müll. in Hedwigia 38: 99 (1899). *Hydrogonium afrofontanum* (C. Müll.) Hilp. in Beih. bot. Zbl. 50: 632 (1933).

Plants long, light to dark green; aquatic to semi-aquatic, tufaceous saxicolous (didymodontoliths). *Stems* flaccid, to 50 mm long, green to blackish; in section round, central strand very small, of 4–5 cells, inner cortical cells lax, outer cortical cells in 2–3 rows, smaller, incrassate. *Leaves* distant, lax, spreading, frequently lime-encrusted; broadly lanceolate to triangular-lanceolate, 2–3 mm long; apex obtuse; margins plane, entire, frequently indistinctly bordered. *Costa* ending 2–5 cells below apex or percurrent, ventral and dorsal superficial cells rectangular, smooth; in section subround, guide cells 4, ventral stereid band small, 1–2 cells thick over central guide cells, ventral surface cells larger, incrassate, dorsal stereid band 3–4 cells thick, dorsal surface cells larger, incrassate. *Upper laminal cells* hexagonal, quadrate or short-rectangular, superficially bulging, smooth or occasionally with 1–2 indistinct papillae in upper leaf; marginal cells in 4–5 rows, narrower, weakly incrassate, rectangular to quadrate; in section frequently forming indistinct, elliptical border; basal cells elongate-rectangular, becoming somewhat narrower toward margin. *Gemmae* axillary, multicellular, fusiform, brown or green.

Sporophyte unknown. Fig. 71: 28–34.

Barbula afrofontana is presently known only from eastern and Southern Africa. In the Flora area, the species occurs in or around waterfalls or seepage areas in South West Africa/Namibia, eastern Transvaal, Natal, Transkei and eastern Cape. Map 92.

Vouchers: *Cholnoky* 853; *Giess* 8993; *Phelan & Smook* 70; *Van Rooy* 283.

The species is identified by its semi-aquatic nature, flaccid habit, subpercurrent costa, smooth leaf cells and weak leaf border. The border on leaf margins is rarely obvious, since it consists of slightly enlarged and thickened marginal cells.

Insufficiently Known Species

Barbula anoectangiacea C. Müll. in Hedwigia 38: 105 (1899). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n. The type has not been seen. Brotherus in Natürl. PflFam. 1: 403 (1902) suggested that this was a species of *Ceratodon*.

Barbula flexicaulis C. Müll. in Hedwigia 38: 107 (1899). Type: Orange Free State, Taaiboschkranz, *Rehmann* s.n., 1875. The type has not been seen. Brotherus in Natürl. PflFam. 1: 411 (1902) suggested, after examining the specimen, that it was a *Schistidium*. Sim (1926) referred the species to *Grimmia apocarpa*, although he had not seen the type.

Barbula perlinearis C. Müll. in Hedwigia 38: 107 (1899). Type: Transvaal, Lydenburg, *Wilms* s.n., Feb. 1888. The type has not been seen. Sim's (1926) treatment of this species under *Didymodon xanthocarpus* (C. Müll.) Magill (as *Barbula xanthocarpa* C. Müll.), does not appear correct, since the description and known distribution of that species do not correspond with those of *B. perlinearis*.

Barbula pertorquata C. Müll. in Hedwigia 38: 109 (1899). Type: Cape, Cape Town, *Rehmann* s.n., 1875. The type has not been seen. Sim (1926) refers the species to *Didymodon xanthocarpus* (C. Müll.) Magill (as *Barbula xanthocarpa* C. Müll.).

5. BRYOERYTHROPHYLLUM

Bryoerythrophyllum *Chen* in Hedwigia 80: 4 (1941); Zander in Bryologist 81: 541 (1978). Type species: *B. recurvirostrum* (Hedw.) Chen.

Plants small to medium, loosely caespitose or in dense tufts, reddish; terricolous or saxicolous. *Stems* erect, branching by subperichaetial innovations; central strand present. *Leaves* distant or rather dense; ligulate to narrowly lanceolate; apex acute, mucronate; base

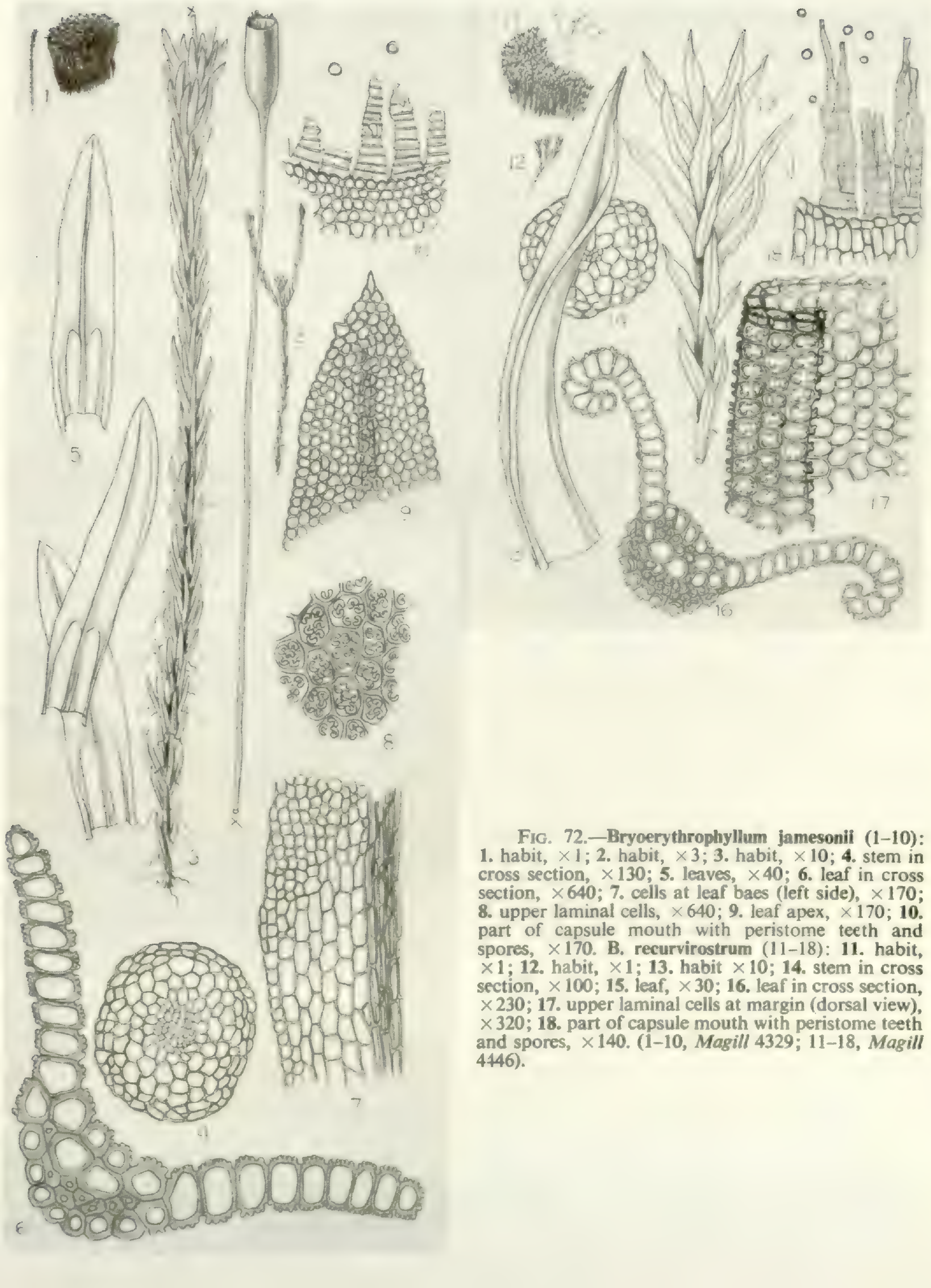


FIG. 72.—**Bryoerythrophyllum jamesonii** (1–10): **1.** habit, ×1; **2.** habit, ×3; **3.** habit, ×10; **4.** stem in cross section, ×130; **5.** leaves, ×40; **6.** leaf in cross section, ×640; **7.** cells at leaf baes (left side), ×170; **8.** upper laminal cells, ×640; **9.** leaf apex, ×170; **10.** part of capsule mouth with peristome teeth and spores, ×170. **B. recurvirostrum** (11–18): **11.** habit, ×1; **12.** habit, ×1; **13. habit** ×10; **14.** stem in cross section, ×100; **15.** leaf, ×30; **16.** leaf in cross section, ×230; **17.** upper laminal cells at margin (dorsal view), ×320; **18.** part of capsule mouth with peristome teeth and spores, ×140. (1–10, *Magill* 4329; 11–18, *Magill* 4446).

clasping or appressed; margins plane to revolute, entire or irregularly toothed near apex. *Costa* short-excurrent; with dorsal and ventral stereid bands. *Laminal cells* quadrate to short-rectangular, papillose; basal cells larger, rectangular, smooth.

Paroicous to dioicous. *Capsule* long-exserted, short-cylindrical; peristome fragile, teeth linear, spiculate; operculum short-conic to rostrate; calyptra cucullate, smooth; spores subround, smooth.

Bryoerythrophyllum, with 17 species, is best represented in Eurasia. Only 7 of these species are recognized in the Americas and only the two most widely distributed species are known from Africa and Australia. In Southern Africa the genus is found at upper elevations of the Drakensberg and forests of Natal and eastern Transvaal.

1 Leaf margins plane above mid-leaf ..... 1. *B. jamesonii*
1 Leaf margins revolute to near apex ..... 2. *B. recurvirostrum*

1. **Bryoerythrophyllum jamesonii** (*Tayl.*) *Crum* in Svensk bot. Tidskr. 51: 200 (1957); Zander in Bryologist 81: 549 (1978). Type: Ecuador, Pichincha, Quito, *Jameson* 88 (NY).

Barbula jamesonii Tayl. in J. Bot., Lond. 5: 48 (1846).

Didymodon afrorubellus Broth. & Wag. ex Dix. in Trans. R. Soc. S. Afr. 8: 194 (1920); Broth. in Natürl. PflFam. 10: 273 (1924); Sim, Bryo. S. Afr. 248 (1926). *Bryoerythrophyllum afrorubellum* (Broth. & Wag.) De Sloover in Bull. Jard. nat. bot. Belg. 49: 398 (1979). Type: Natal, Van Reenens Pass, *Wager* 79 (PRE, holo.!; BM!; H).

Plants small to medium, in dense or loose tufts, dark green, reddish brown below; terricolous or saxicolous. *Stems* erect to inclined, 2–15 mm high, branching; in section angular, central strand present, inner cortical cells large, outer cortical cells in 1–3 rows, stereids or substereids. *Leaves* incurved, contorted dry, erect-spreading wet, somewhat distant; ligulate to oblong-lanceolate, 1,0–1,5 mm long; apex acute, mucronate; base appressed to stem; margins frequently recurved just above base, plane above, entire or irregularly dentate by smooth, yellowish marginal cells. *Costa* short-excurrent, ventral superficial cells quadrate to short-rectangular, papillose, dorsal superficial cells elongate, incrassate, sparsely papillose; in section reniform, guide cells 4, ventral stereid or substereid band 1 cell thick, ventral surface cells incrassate, papillose, dorsal stereid band 2–4 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* quadrate to rounded-quadrate, with 4–6 low, blunt papillae over lumen; basal cells larger, well defined, rectangular, smooth, reddish yellow.

Dioicous. Male plants somewhat smaller, perigonia terminal; leaves with broadly sheathing bases. Perichaetia terminal; leaves oblong-lanceolate, to 2 mm long. *Seta* 0,7–1,2 mm long, reddish; capsule cylindrical, 1,0–1,2 mm long, reddish brown; peristome fragile, teeth erect, linear, frequently perforated below, spiculate, reddish yellow; operculum conical, 0,6 mm long; spores round, 17–20 μm, granulate to smooth. Fig. 72: 1–10.

New to Southern Africa, *B. jamesonii* is known from Scotland, British Columbia, Central and South America, India, China, Australia and New Zealand. In Southern Africa, *B. jamesonii* is most frequently collected in the mountain grasslands of Lesotho, eastern Orange Free State and western Natal. The species is sporadically collected in forests or sheltered kloofs of the Transvaal and central Natal and several specimens are also known from the mountains of the southwestern Cape. Map 96.

Vouchers: *Brenan* M2847; *Cholnoky* 17; *Magill* 4329, 4510, 5133.

Bryoerythrophyllum jamesonii is generally defined by the reddish tint of the plants, small leaves with plane margins, highly differentiated basal cells and the few apical teeth. A few specimens have been seen that lack the reddish colouration and/or apical teeth on the leaves, but have been identified by a combination of other characters including habit, leaf shape, basal leaf cells and sporophyte.

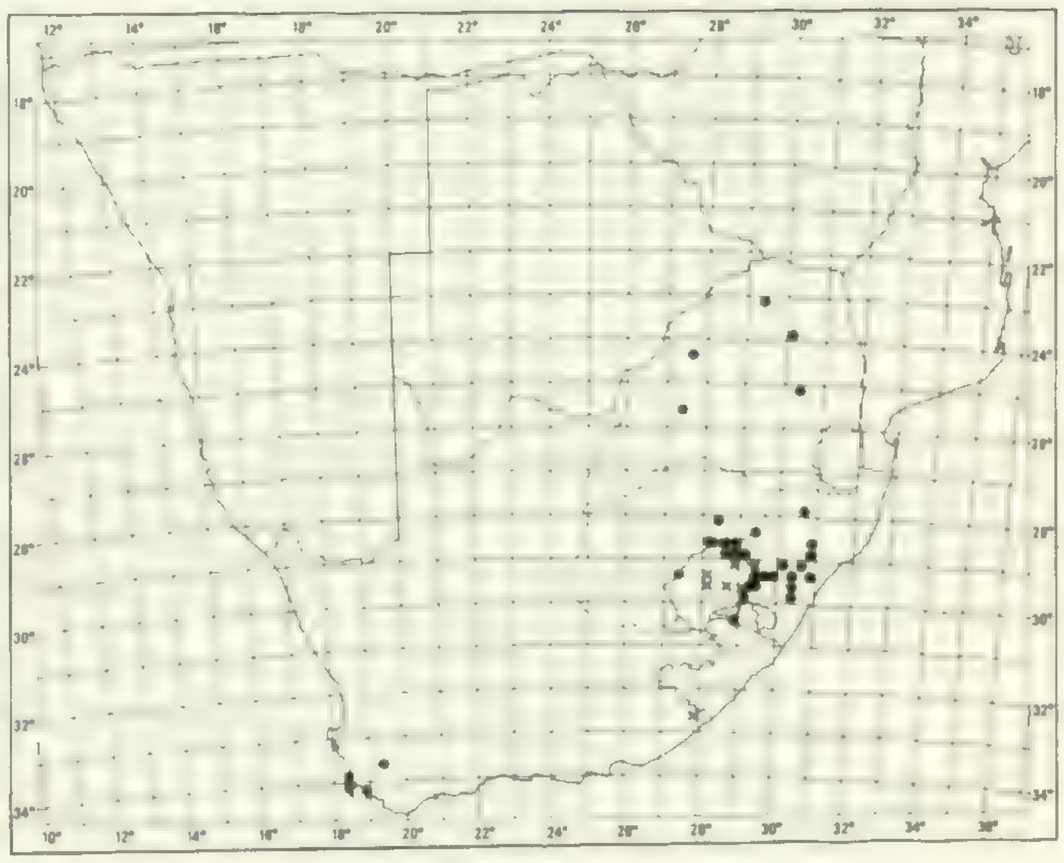
2. **Bryoerythrophyllum recurvirostrum** (*Hedw.*) *Chen* in Hedwigia 80: 5 (1941); Zander in Bryologist 81: 542 (1978). Type: Europe.

Weissia recurvirostris Hedw., Spec. Musc. 71 (1801).

Plants small to medium, forming dense tufts or cushions, brownish green above, reddish below; terricolous or saxicolous. *Stems* erect, 0,5–20,0 mm high, branching;

in section with large central strand, inner cortical cells lax, outer cortical cells in 1–2 rows, small, incrassate, red. *Leaves* contorted dry, erect-spreading wet, dense; lanceolate to linear-lanceolate above ovate to oblong base, 2,0–3,5 mm long; apex acute, mucronate; margins revolute to apex, entire or frequently with a few yellowish teeth at apex. *Costa* short-excurrent, ventral superficial cells quadrate, incrassate, papillose, dorsal superficial cells elongate, incrassate, papillose; in section suboval, guide cells 2–4(–6), lateral guide cells sometimes smaller, ventral stereid band small, 2 cells thick, surface cells larger, incrassate, papillose, dorsal stereid band 3–4 cells thick, surface cells slightly larger, outer walls strongly incrassate, lumens lunate. *Upper laminal cells* quadrate to rectangular, rarely a few cells transversely rectangular, papillose, 3–4 low, C-shaped papillae covering cell; marginal cells papillose; basal cells rectangular, smooth, red-brown.

Paroicous. Perichaetial leaves with wide, sheathing base. *Seta* straight, 5–7 mm long, red-brown; capsule short-cylindrical, 1,0–1,5 mm long, dark red when mature, light brown when old; peristome teeth erect, linear, cleft or perforated above middle, spiculate, yellowish; operculum obliquely rostrate, to 0,6 mm long; spores subround, 17–20 μm, smooth. Fig. 72: 11–18.



MAP 96.— ● **Bryoerythrophyllum jamesonii**
× **Bryoerythrophyllum recurvirostrum**

Widespread in the Northern Hemisphere, *B. recurvirostrum* is uncommon or rare in Africa (Bizot *et al.*, 1978) Australia and New Zealand and unknown in South America. In Southern Africa the species is found in the subalpine grasslands of Lesotho and Natal, and forest in the eastern Cape. Map 96.

Vouchers: *Jacot Guillarmod* 4583; *Magill* 4195, 4446.

The species is identified by its reddish colouration, lanceolate leaves with recurved margins, apical teeth and strongly differentiated basal leaf cells. The size of the plants, leaf shape and recurved margins distinguish *B. recurvirostrum* from *B. jamesonii*.

Subfamily TRICHOSTOMOIDEAE

Plants small to large, in loose tufts or scattered individuals; terricolous, saxicolous or corticolous. *Stems* erect; central strand present or absent. *Leaves* generally narrow, linear to lanceolate or oblong to elliptical, rarely narrowly spatulate; margins plane to involute. *Costa* subpercurrent to short-excurrent, rarely long-excurrent; in section with dorsal and ventral stereid bands. *Upper laminal cells* small, quadrate, papillose; junction with basal cells straight across leaf or basal cells extending up margins forming distinct V-shaped junction with laminal cells. Gemmae absent.

Capsules cylindrical; peristome present or absent, teeth short, erect or long-filamentous, generally twisted; operculum rostrate; calyptra cucullate, long.

Key to Genera of Subfamily Trichostomoideae

1 Leaves bistratose above base:
  2 Leaves bistratose juxtacostally; costa subpercurrent ..... **3. Timmiella**
  2 Upper lamina bistratose throughout; costa long-excurrent ..... **4. Tortella**

1 Leaves unistratose above base:
3 Leaves broadly lanceolate to lingulate; capsules exserted, cleistocarpic *or* immersed, stegocarpic:
4 Capsules cleistocarpic, longitudinally ridged dry; leaf margins plane; costa broad, percurrent ..... 1. **Tetrapterum**
4 Capsules stegocarpic, immersed, gymnostomous; leaf margins erect, incurved above; costa mucronate ..... 2. **Phasconica**
3 Leaves linear-lanceolate to oblong; capsules long-exserted, stegocarpic:
5 Basal hyaline cells extending up margins in lower $\frac{1}{3}$–$\frac{1}{2}$ of leaf, forming distinct V-shaped area in leaf base; peristome long, twisted ..... 4. **Tortella**
5 Basal hyaline cells not forming V-shaped area or only weakly so, junction with upper laminal cells ± straight across leaf; peristome present or absent, generally short, not twisted:
6 Central strand of stem absent ..... 5. **Oxystegus**
6 Central strand of stem present:
7 Leaves narrowly spathulate to elliptical; margins plane ..... 6. **Trichostomum**
7 Leaves linear-lanceolate to oblong; margins incurved to involute ..... 7. **Weissia**

1. TETRAPTERUM

Tetrapterum *Hampe ex Jaeg.* in Verh. St Gall. naturw. Ges. 1868–69: 85 (1869); Broth. in Natürl. PflFam. 10: 252 (1924); Sim, Bryo. S. Afr. 254 (1926). Type species: *T. australe* Hampe.

Plants small, light or yellow-green; terricolous. *Stems* erect; central strand present. *Leaves* broadly lanceolate above oval or oblong base; margins plane, entire. *Costa* strong, short-excurrent, broad below. *Upper laminal cells* quadrate, with 4–6 O-shaped papillae over lumen.

Seta short; capsule exserted, cleistocarpic, urn longitudinally ridged dry, bluntly beaked.

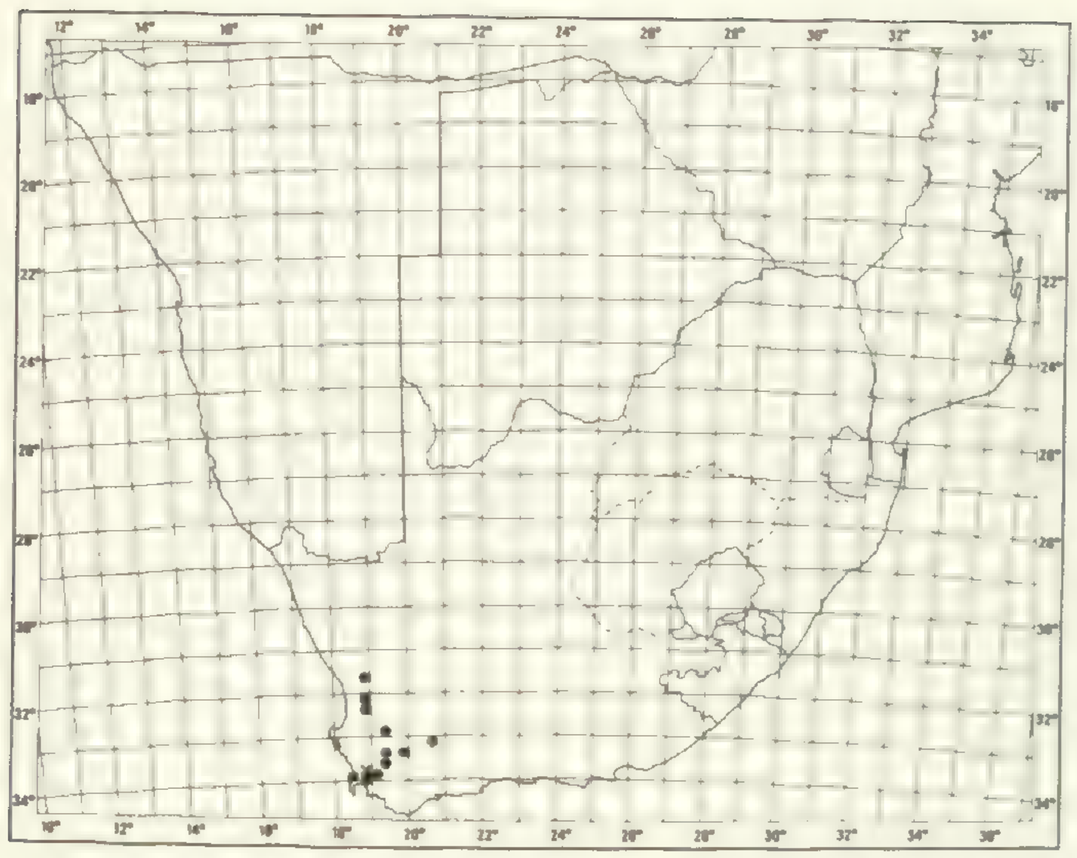
Eleven species are currently recognized for *Tetrapterum*. The genus is known as far north as Central America, but is mainly restricted to southern South America, Southern Africa and Australia. The genus is recognized by broad leaves with plane margins, the presence of dorsal and ventral stereid bands in the costa, and cleistocarpic capsules.

Tetrapterum tetragonum (*Hook.*) *Andrews* in Bryologist 48: 191 (1945); Sim, Bryo. S. Afr. 254 (1926). Type: Cape, Tiger Berg, *Mund* s.n.

Phascum tetragonum Hook. in Bot. Misc. 1: 124 (1829). *Astomum tetragonum* (Hook.) Broth. in Natürl. PflFam. 1: 385 (1902).

Plants small, loosely caespitose, yellow-green; terricolous. *Stem* 2–4 mm tall, rarely branched; in section round, central strand large, cortical cells in 5–6 rows, thin-walled, smaller toward margin. *Leaves* spirally twisted around stem dry, erect-spreading wet; lanceolate, 1,5–1,8 mm long; apex acute, mucronate; base oblong or oval, erect-sheathing; margins plane, entire. *Costa* short-excurrent as 2–3 clear, smooth cells, ventral and dorsal superficial cells quadrate, papillose; in section reniform, guide cells 4–8, ventral stereid band 2–3 cells thick, ventral surface cells larger, quadrate, incrassate, papillose, dorsal stereid band 3–4 cells thick, dorsal surface cells quadrate, incrassate, papillose. *Upper laminal cells* quadrate, thin-walled, papillae low, 4–6 over lumen, O-shaped; basal cells rectangular, thin-walled, hyaline, smooth.

Autoicous. Perigonia lateral on short branches; perichaetia terminal, leaves undifferentiated. *Seta* 1 mm long, yellow; capsule



MAP 97.— ● **Tetrapterum tetragonum**
× **Phasconica tisserantii**

cleistocarpic, urn elliptical, bluntly beaked, with strong longitudinal ridges dry, ± quadrate in median transverse section, 1,5 mm long, red-yellow; exothecial cells rectangular, thin-walled; stomata phaneropore, present at base of urn; calyptra cucullate, obliquely beaked; spores round, 20–25 μm, papillose. Fig. 73: 1–9.

Endemic to Southern Africa, *Tetrapterum tetragonum* is infrequently collected in dry shrublands of the southwestern and northwestern Cape. Map 97.

Vouchers: *Goldblatt* 619; *Magill & Schelpe* 3861, 3870; *Schelpe* 7628.

The leaf shape and costal anatomy are quite distinctive and help to identify sterile specimens. The cleistocarpic, orange capsules, produced in abundance, are strongly ridged when dry and are more or less rectangular wet. The distinctive capsules characterize specimens of *Tetrapterum*.

2. PHASCONICA

Phasconica *C. Müll.* in Linnaea 43: 438 (1882). Type species: *P. lorentzii* C. Müll.

Plants small, gregarious, yellow-green; terricolous. *Stems* to 1 mm high; central strand present. *Leaves* broadly lanceolate to lingulate; margins erect to incurved above, entire. *Costa* short-excurrent; with dorsal and ventral stereid bands. *Upper laminal cells* quadrate, incrassate, papillose.

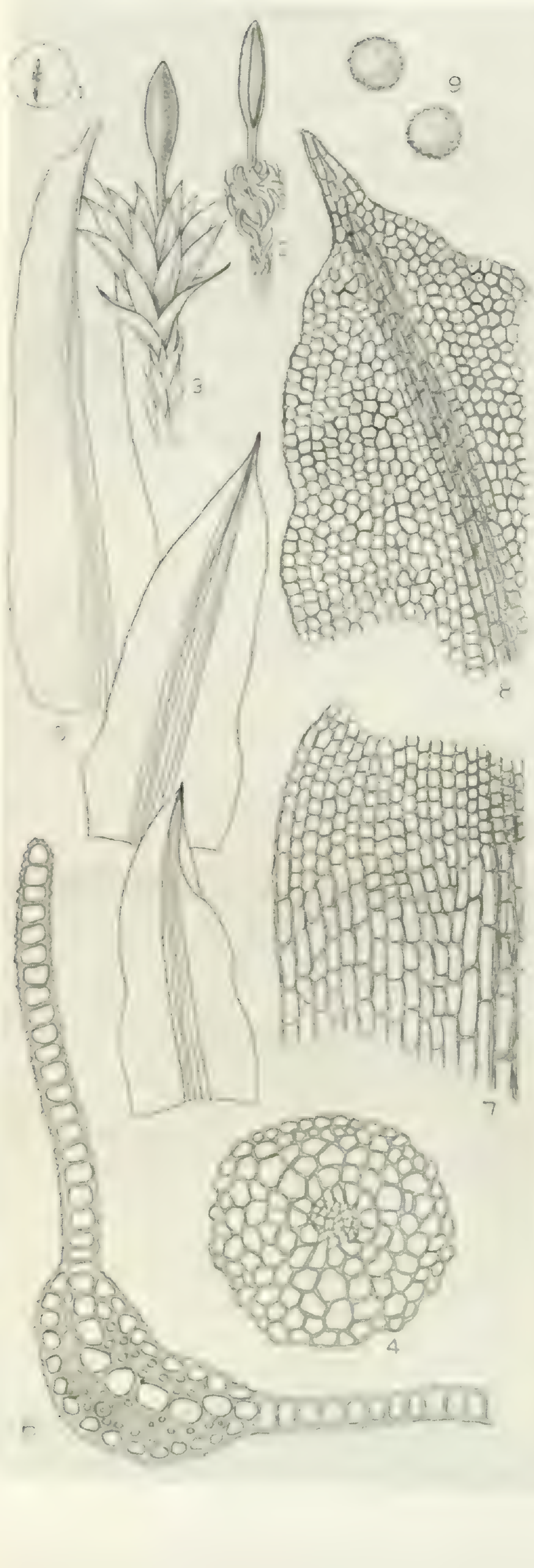
Seta very short; capsule cyathiform, gymnostomous; operculum plano-convex, abruptly rostrate; calyptra cucullate.

The genus *Phasconica* comprises three species from widely separated regions. The African species, *P. tisserantii* P. Varde, is known from central and Southern Africa; *P. lorentzii* C. Müll. is known from South America and *P. balansae* C. Müll. occurs in Oceania. Saito (1975) recently included the genus in the synonomy of *Weissia* Hedw. without explanation. Judging from Müller's descriptions only, Saito's decision appears to be correct; however, I have not seen the latter two species. The African species is not a *Weissia*. It bears a strong gametophytic resemblence to *Trichostomum* Bruch, but sporophytically, the two genera are very different. The relationship between *Phasconica*, in the African sense, and *Trichostomum* is reminiscent of the relationship between *Weissia* and the segregate genera *Astomum* Hampe and *Hymenostomum* R. Br.

Phasconica tisserantii *P. Varde* in Revue bryol. lichen. 7: 231 (1935). Type: Central African Republic, Bozoum, *Tisserant* s.n. (PC).

Plants small, gregarious, yellow-green; terricolous. *Stems* to 1 mm tall, simple; in section round, central strand present, cortical cells incrassate. *Leaves* larger above, incurved-contorted dry, spreading wet; lanceolate to ligulate, 2–3 mm long; apex acute, mucronate; base scarcely differentiated; margins plane to erect below, incurved above, entire. *Costa* short-excurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells rectangular, smooth; in section semicircular, guide cells 4, ventral stereid band 2 cells thick, ventral surface cells similar to laminal cells, papillose, dorsal stereid band 4–5 cells thick, dorsal surface cells substereids. *Upper laminal cells* quadrate to subquadrate, incrassate, with 4–6 low, blunt papillae over lumen; basal cells rectangular to long-hexagonal, lax, smooth.

Dioicous. Perigonia not seen; perichaetia terminal, leaves ligulate, 3 mm long. *Seta* erect, 0,3 mm long, yellowish; capsule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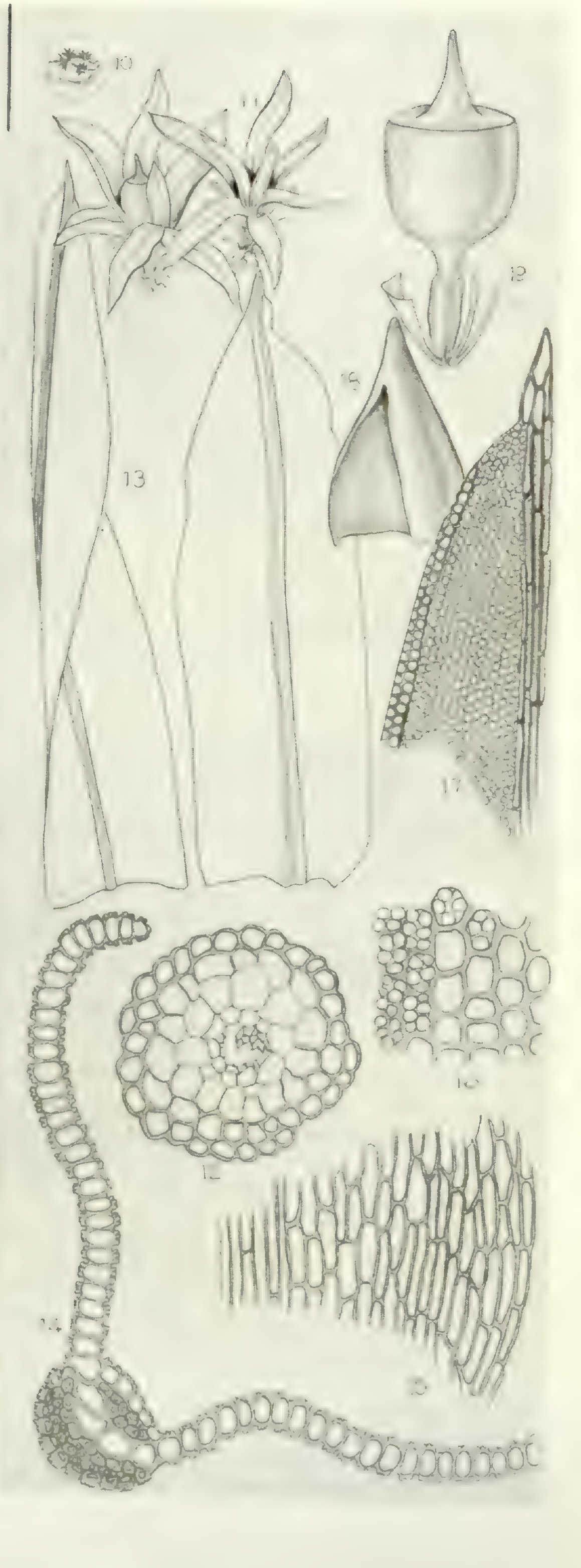
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immersed, cyathiform, to 1 mm long, yellowish, mouth red; stomata not seen; vaginula oval-cylindrical, to 0,8 mm long; peristome absent; operculum plano-convex, abruptly rostrate, 0,6 mm in diameter, 0,5 mm high, cells not twisted; spores round, (24–) 27–30 μm, strongly papillose. Fig. 73: 10–19.

The species is known from central Africa and mountains of the southwestern Cape. Map 97.

Voucher: *Garside* 6697.

The strongly costate leaves and immersed, operculate capsule are quite distinctive in Southern Africa and will identify *P. tisserantii*. Some doubt exists as to the generic position of this species since Saito (1975) considered *Phasconica* a synonym of *Weissia*. This species is only very distantly related to *Weissia* and may require a new combination if Mueller's types are indeed *Weissia* sens. lat. Gametophytically *P. tisserantii* resembles *Trichostomum brachydontium*, but the large, immersed, cup-shaped, gymnostomous capsule clearly distinguishes it from that species.

3. TIMMIELLA

Timmiella (*De Not.*) *Limpr.*, Laubm. Deutschl. 1: 590 (1888); Broth. in Natürl. PflFam. 10: 261 (1924). Type species: *T. anomala* (B.S.G.) Limpr.

Plants small, dark green; terricolous. *Stems* erect; central strand present. *Leaves* bistratose; ligulate above oval base; in section bistratose juxtacostally, dorsal cells smaller; margins irregularly serrate. *Costa* subpercurrent, dorsal and ventral stereid bands present. *Laminal cells* quadrate, smooth or mammillose; basal cells lax.

Sporophyte terminal. *Seta* long, flexuose or straight; capsule cylindrical; peristome teeth filamentous, straight or twisted.

The 15 species of *Timmiella* are scattered throughout the world with the exception of Australia and New Zealand. Two species are widespread in the Northern Hemisphere; the other species are rather local in distribution. The genus is easily identified by its unusual leaf anatomy. In addition to *T. pelindaba*, 4 other species occur in central or northern Africa.

Timmiella pelindaba *Magill* in Mem. bot. Surv. S. Afr. 43: 3 (1979). Type: Transvaal, Pelindaba, *Bosman* PRE-CH1607 (PRE, holo.!; H; L; MO; NY).

Plants small, gregarious, dark green; terricolous. *Stems* to 5 mm high, unbranched; in section round, central strand small, inner cortical cells lax, outer 2–3 rows incrassate, reddish; axillary hairs of 6–8 cylindrical cells, hyaline throughout. *Leaves* crisped with involute margins dry, widely spreading to recurved with plane margins wet; bistratose juxtacostally; ligulate, 3,5–4,5 mm long; apex acute; base oval; lamina frequently constricted above base; margins plane, irregularly serrate in distal $\frac{2}{3}$, entire below. *Costa* strong, subpercurrent, very wide below, ventral superficial cells quadrate, smooth, dorsal superficial cells quadrate, smooth; in section round, guide cells 4, ventral stereid band small, 1–2 cells thick, ventral surface cells similar to ventral laminal cells, dorsal stereid band 3–4 cells thick, dorsal surface cells substereids, ± irregular. *Upper laminal cells* quadrate, mammillose ventrally, smooth dorsally; in section dorsal cells extending about halfway to margin, c. 15 cells each side of costa, half as high as ventral cells; basal cells lax, oblong-hexagonal, thin-walled.

Dioicous. Perichaetial leaves not differentiated. *Seta* straight wet or dry, 12 mm

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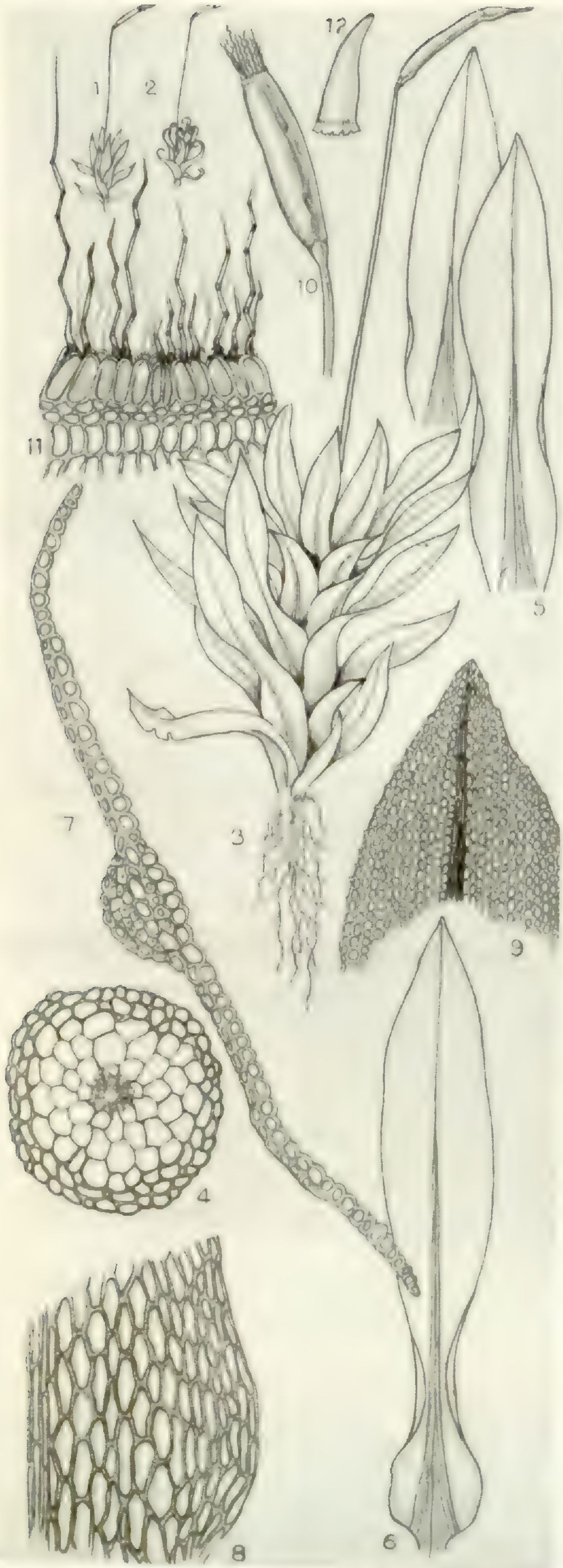
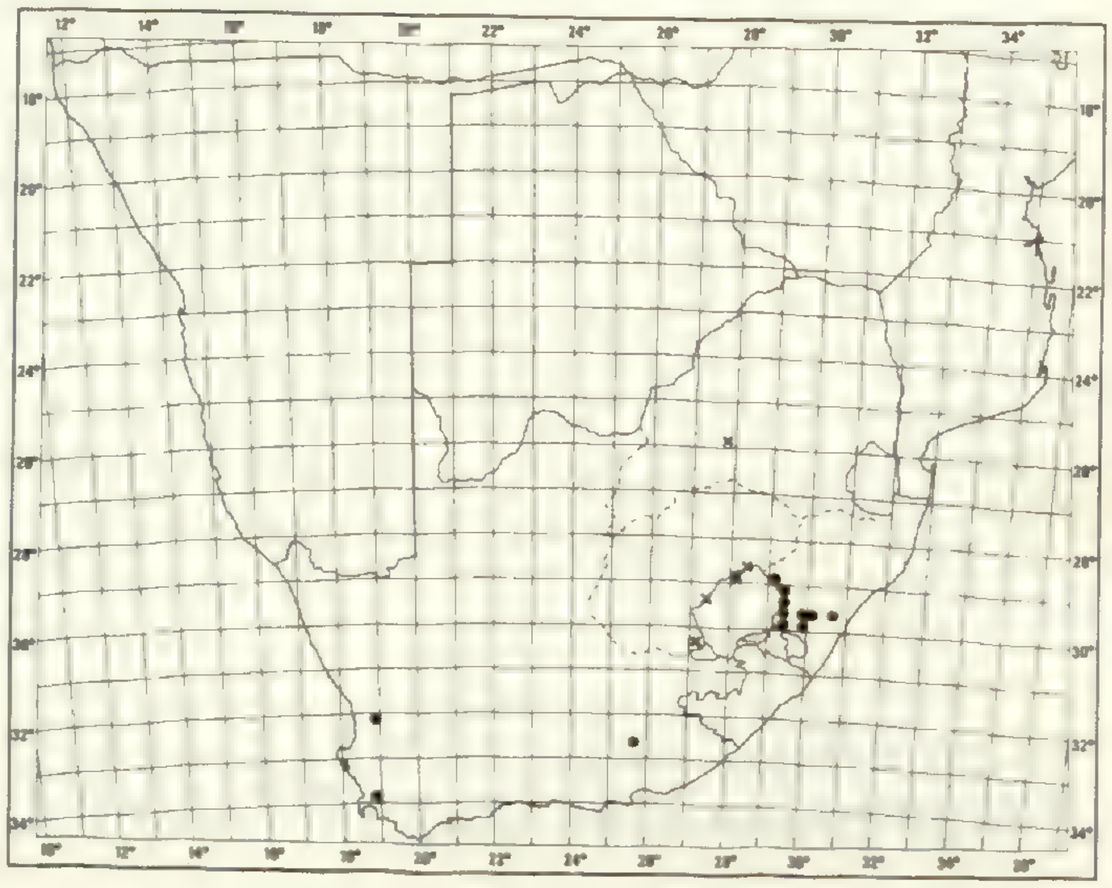
FIG. 73.—**Tetrapterum tetragonum** (1–9): **1.** habit, ×1; **2.** habit, dry, ×10; **3.** habit, wet, ×10; **4.** stem in cross section, ×170; **5.** leaves, ×40; **6.** leaf in cross section, ×235; **7.** cells at leaf base (left side), ×170; **8.** leaf apex (papillae partly shown), ×170; **9.** spores, ×270. **Phasconica tisserantii** (10–19): **10.** habit, ×1; **11.** habit, ×10; **12.** stem in cross section, ×170; **13.** leaves, ×30; **14.** leaf in cross section, ×250; **15.** cells at leaf base (right side), ×170; **16.** upper laminal cells (papillae partly shown), ×640; **17.** leaf apex (dorsal left side), ×170; **18.** calyptra, ×30; **19.** capsule, ×30. (1–9, *Giffen* PRE-CH7723; 10–19, *Garside* 6697).



long, reddish; capsule cylindrical, 2 mm long, reddish yellow; exothecial cells oblong; annulus well developed, persistent; peristome teeth straight, long-filiform, 350–400 μm high, ± smooth, reddish yellow, connected at base and forming a very short tube; operculum long-rostrate, 1 mm long; calyptra cucullate, 3,5 mm long; spores round, 12–15 μm, essentially smooth. Fig. 74: 1–12.

Endemic to Southern Africa, this species is known from kloofs in the grasslands of central Transvaal, Lesotho and southeastern Orange Free State. Map 98.



MAP 98.— ● **Oxystegus cylindricus**
× **Timmiella pelindaba**

Vouchers: *Smook* 2319a; *Van Rooy* 597.

The species is near the central African *T. cameruniae* Broth., but differs in leaf length and shape, plane margins and straightness and length of the seta. It differs from other African species of *Timmiella* by its dioicous condition, well developed annulus and straight peristome teeth.

FIG. 74.—**Timmiella pelindaba: 1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, ×10; **4.** stem in cross section, ×125; **5–6.** leaves, ×20; **7.** leaf in cross section, ×260; **8.** cells at leaf base (right side), ×120; **9.** leaf apex, ×170; **10.** capsule, ×10; **11.** capsule mouth and part of peristome teeth, ×90; **12.** operculum, ×10. (1–12, *Bosman* PRE-CH1607).

4. TORTELLA

Tortella (*Lindb.*) *Limpr.*, Laubm. Deutschl. 1: 520 (1888), nom. cons.; Saito in J. Hattori bot. Lab. 39: 440 (1975). Type species: *T. caespitosa* (Schwaegr.) Limpr.

Plants small to large, forming tufts or cushions; terricolous, saxicolous or corticolous. *Stem* erect, central strand present or absent; axillary hairs of 10–20 cells, hyaline throughout. *Leaves* incurved, variously contorted dry; linear-lanceolate to oblong; margins plane, entire. *Costa* short to long-excurrent. *Laminal cells* quadrate to short-rectangular, incrassate, papillose or surface sometimes strongly thickened to mammillose; basal cells strongly differentiated, hyaline, smooth, extending up margins further than costa, forming distinct V-shaped interface between basal and laminal cells.

Autoicous. Perigonia on short lateral branches; perichaetia terminal, leaves undifferentiated. *Capsule* cylindrical; peristome long, twisted, teeth filiform above very short basal membrane; operculum conic-rostrate; calyptra cucullate, long; spores papillose.

The genus *Tortella* contains 63 species evenly distributed throughout the world, with the exception of Antarctica. A few of the species, i.e. *T. humilis* and *T. fragilis*, are almost cosmopolitan. The genus, although not common, is found throughout Southern Africa and is recognized by its narrow leaves with plane margins, costa with dorsal and ventral stereid bands, basal leaf cells extending well up leaf margins and long, twisted peristome teeth above a short basal membrane.

1 Leaves long-subulate, rigid wet or dry, bistratose above; costa long-excurrent, fragile.....3. *T. fragilis*
1 Leaves unistratose throughout; costa short-excurrent or mucronate:
2 Leaves oblong; apex broad, obtuse or rarely acute.....2. *T. humilis*
2 Leaves lanceolate to linear; apex narrow, acute or occasionally obtuse.....1. *T. xanthocarpa*

1. **Tortella xanthocarpa** (*C. Müll.*) *Broth.* in Natürl. PflFam. 1: 397 (1902). Type: Cape, Saldanha Bay, *Breutel* s.n. (H-BR!).

Trichostomum xanthocarpum Schimp. ex C. Müll. in Bot. Ztg 17: 229 (1859).

Trichostomum tortuloides Sull. & Lesq. in Proc. Am. Acad. Arts Sci. 4: 277 (1859); Sim, Bryo. S. Afr. 244 (1926). *Tortella tortuloides* (Sull. & Lesq.) Broth. in Natürl. PflFam. 1: 397 (1902). Type: Cape, Simonstown, *C. Wright* s.n., 1853 (FH, holo.!).

Trichostomum rufisetum C. Müll. in Hedwigia 38: 99 (1899); Sim, Bryo. S. Afr. 243 (1926). *Tortella rufiseta* (C. Müll.) Broth. in Natürl. PflFam. 1: 397 (1902). Type: Cape, Blanco, *Rehmann* sub 45 (*Rehmann* 115, PRE!; BM!; vide Dix. & Gepp, 1923).

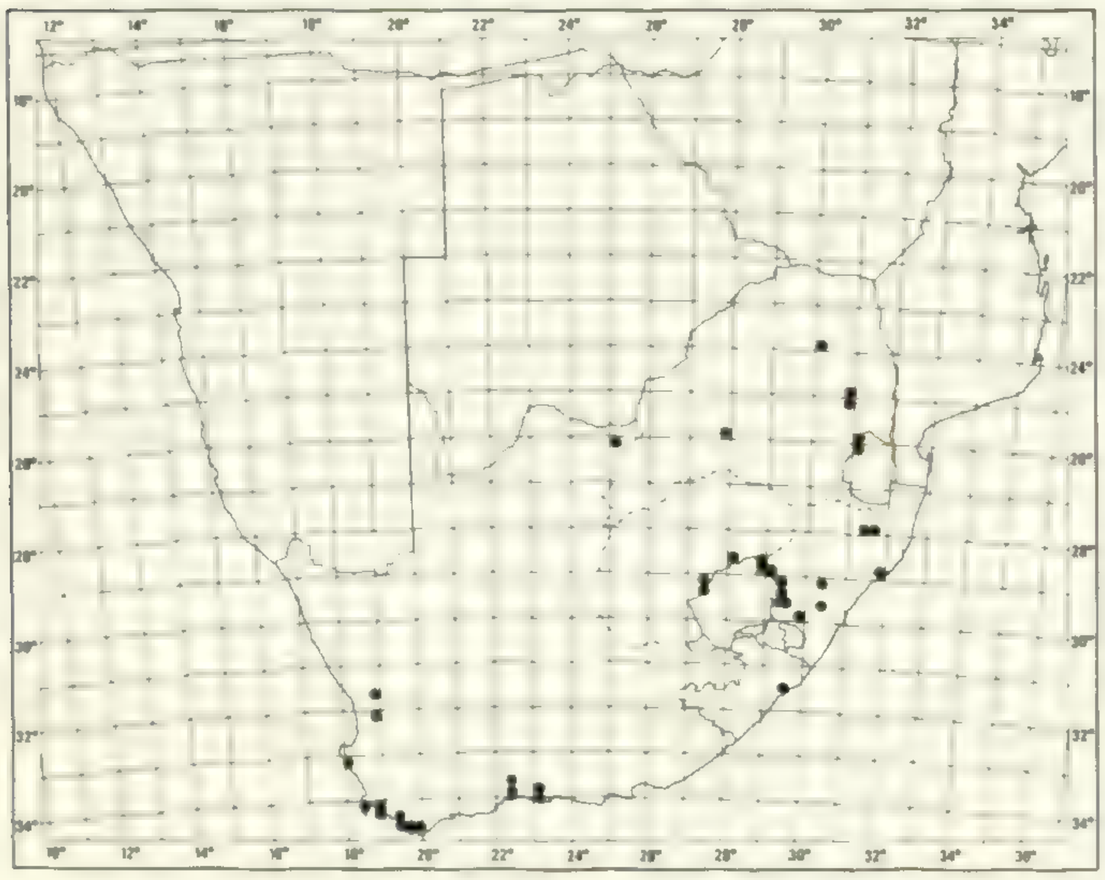
Trichostomum rehmannii Sim, Bryo. S. Afr. 244 (1926). Type: Transvaal, Pilgrims Rest, *Maclea* s.n. (*Rehmann* 471; PRE, holo.!).

Plants small, caespitose, green to yellow-green, brownish below; terricolous, corticolous or rarely saxicolous. *Stems* 1–5 mm tall, occasionally branching; in section round, central strand small, cortical cells incrassate, smaller and reddish toward margin. *Leaves* crowded above, contorted to incurved dry, erect-spreading wet, somewhat fragile; linear to lanceolate, 2,5–4,0 (–5,0) mm long; apex acute or occasionally some leaves obtuse, frequently mucronate; base oval to oblong; margin plane, entire or occasionally irregular above through displaced cells. *Costa* short-excurrent, ventral superficial cells quadrate, papillose or mammillose, dorsal superficial cells rectangular to linear, smooth; in section subround, guide cells 4, large, ventral stereid band 2–3 cells thick, ventral surface cells similar to laminal cells, papillose or mammillose, dorsal stereid band 2–5 cells thick, dorsal surface cells not differentiated. *Upper laminal cells* quadrate to short-rectangular, weakly thickened, superficially bulging, papillose to weakly papillose, 4–6 over lumen, low, blunt or strongly thickened and becoming mammillose, appearing smooth in surface view; basal cells rectangular, lax, hyaline, smooth, extending up margins, restricted to lower $\frac{1}{4}$ or extending to mid-leaf.

Autoicous. Perigonia on short lateral branches; perichaetia terminal, leaves undifferentiated. *Seta* 6–10 (–15) mm long, reddish yellow; capsule cylindrical, 2 mm long; peristome present, yellowish red, inserted at mouth, teeth filiform above very short basal membrane, 0,5 mm high, twisted counterclockwise; operculum rostrate, 0,8 mm long; calyptra cucullate, covering urn; spores

round, 15–17 μm, weakly papillose. Fig. 75: 11–28.

Endemic to Southern Africa, *T. xanthocarpa* is most frequently collected in forests or wooded areas of the southern and western Cape and in mountainous regions of the Orange Free State and Natal. A few collections are also known from scattered wooded areas in Swaziland, Transvaal, Zululand and northern Cape. Map 99.



MAP 99.— ● **Tortella xanthocarpa**
× **Tortella fragilis**

Vouchers: *Hilliard & Burtt* 10115a; *Lewis* 12205; *Magill* 4083, 5523, 5605, 6104, 6291; *Oliver* 7081; *Schelpe* 4008; *Van Rooy* 374, 586.

The lanceolate leaves, acute apex, oval base and short-excurrent costa will separate the typical 'facies' of *T. xanthocarpa* from the other species in Southern Africa. I agree with Dixon (cf. Sim, 1926) that *Trichostomum rehmannii* is a diminutive form of this species and I also find *T. tortuloides* conspecific. *Tortella rufiseta* is also included here as it represents a robust form that is otherwise indistinguishable.

Many of the specimens, collected on tree bark in forests of the Drakensberg and eastern Transvaal, have longer, linear leaves with oblong bases and narrow apices. These specimens may represent an undescribed variety of *T. xanthocarpa*, although there appears to be a fairly continuous gradation between these linear-leaved specimens and the more common lanceolate-leaved plants.

2. **Tortella humilis** (*Hedw.*) *Jenn.*, Man. Moss. W. Pennsylv. 96 (1913); Redfearn in Ann. Mo. bot. Gdn 59: 29 (1972); Crum, Moss. Gt Lakes For. 104 (1972). Type: North America, Pennsylvania.

Barbula humilis Hedw., Spec. Musc. 116 (1801).

Barbula caespitosa Schwaegr., Spec. Musc. Suppl. 1: 120 (1811). *Tortella caespitosa* (Schwaegr.) Limpr., Laubm. Deutschl. 1: 600 (1888); Sim, Bryo. S. Afr. 241 (1926). Type: North America.

Barbula afrocaespitosa C. Müll. in Hedwigia 38: 109 (1899). *Tortella afrocaespitosa* (C. Müll.) Broth. in Natürl. PflFam. 1: 397 (1902). Type: Cape, Krakakamma, *Ecklon* s.n., 1832.

Barbula natalensicaespitosa C. Müll. in Hedwigia 38: 110 (1899); *Tortella natalensicaespitosa* (C. Müll.) Broth. in Natürl. PflFam. 1: 397 (1902). Type: Natal, *Gueinzius* s.n.

Barbula eutrichostoma C. Müll. in Hedwigia 38: 110 (1899); *Tortella eutrichostomum* (C. Müll.) Broth. in Natürl. PflFam. 1: 397 (1902). Type: Cape, Blanco, *Rehmann* s.n., 1875 (PRE!).

Tortella petrieana Sim, Bryo. S. Afr. 242 (1926). Type: Natal, Glynn Falls, *Sim* 10063 (PRE, holo.!).

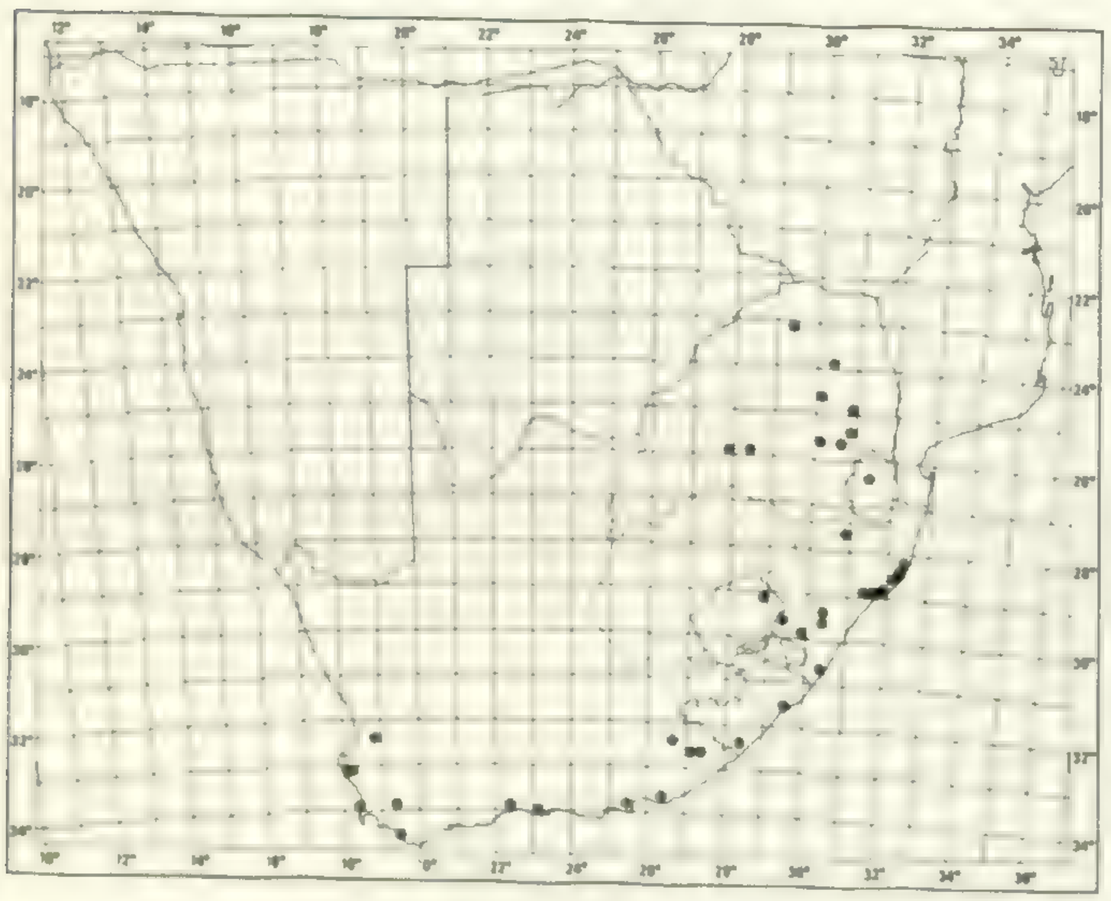
Plants small to medium, loosely caespitose, green to yellow-green; terricolous, saxicolous or corticolous. *Stems* 2–20 mm tall, little branched; in section round, central strand present, cortical cells thin-walled, smaller, incrassate toward margin. *Leaves* incurved, contorted with inrolled margins dry, widespreading wet; oblong to oblong-lanceolate, 3–5 mm long; apex obtuse to broadly acute, mucronate; base scarcely differentiated to oval; margins plane to erect at apex, entire. *Costa* short-excurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells linear, smooth; in section subround, ventrally flattened, guide cells 4, ventral stereid band strong, 2–3 cells thick, ventral surface cells similar to laminal cells, papillose, dorsal stereid band strong, 4–5 cells thick, dorsal surface cells not differentiated. *Upper laminal cells* quadrate

FIG. 75.—**Tortella humilis** (1–10): **1.** habit, ×1; **2.** habit, ×5; **3.** stem in cross section, ×170; **4.** leaf, ×30; **5.** leaf in cross section, ×200; **6.** cells at leaf base (right side), ×170; **7.** upper laminal cells (papillae partly shown), ×640; **8.** leaf apex, ×170; **9.** perigonium, ×60; **10.** part of peristome and spores, ×40. **T. xanthocarpa** (linear leaf facies, 11–18): **11.** habit, ×1; **12.** habit, ×5; **13.** stem in cross section, ×170; **14.** leaves, ×30; **15.** leaf in cross section, ×245; **16.** cells at upper base (left side), ×170; **17.** leaf apex, ×170; **18.** upper laminal cells, ×640. **T. xanthocarpa** (typical facies, 19–28): **19.** habit, ×1; **20.** habit ×5; **21.** leaf, ×30; **22.** leaf in cross section, ×245; **23.** cells at upper leaf base, ×170; **24.** upper laminal cells, ×640; **25.** leaf apex, ×170; **26.** operculate capsule, ×5; **27.** part of capsule mouth with peristome, ×200; **28.** spore, ×700. (1–10, *Jacot Guillarmod* 6171; 11–18, *Magill* 4812; 19–28, *Magill* 5983).

to subquadrate, occasionally angular, thin-walled, superficially bulging, papillae low, mostly 4 over lumen; basal cells rectangular, hyaline, smooth, extending up margin, confined to lower ⅓ of leaf.

Autoicous. Perigonia gemmate, on short lateral branches; perichaetia terminal, leaves not differentiated. *Seta* 7–12 mm long, yellowish; capsule cylindrical, 2–3 mm long, yellow-brown; peristome to 1 mm high, red-yellow, teeth filiform above very short basal membrane, twisted 2–3 turns counterclockwise, papillose; operculum rostrate; calyptra cucullate, covering upper ½ of capsule; spores round, 10–12 μm, papillose. Fig. 75: 1–10.

Tortella humilis is a very widespread species found throughout Africa, America and parts of Europe and Asia. In Southern Africa it is frequently collected in the southwestern, southern and eastern Cape, Transkei, Natal, Zululand, Lesotho, eastern, central and northern Transvaal and Swaziland. Map 100.



MAP 100.— ● **Tortella humilis**

Vouchers: *Bosman* 1608; *Boucher* 3269*b*; *Goldblatt* 2124*d*; *Killick* 4206; *Magill* 4563; *Watson* 1359.

The plant shows some variation in leaf length, in the distance the basal leaf cells extend up the margins and the habitat; but the oblong leaves with obtuse apices separate *T. humilis* from other Southern African species.

3. **Tortella fragilis** (*Hook. & Wils.*) *Limpr.*, Laubm. Deutschl. 1: 606 (1888); Saito in J. Hattori bot. Lab. 39: 445 (1975). Type: North America, *Drummond* 127.

Didymodon fragilis Hook. & Wils. in Drumm., Musci Bor. Am. 127 (1828).

Plants large, forming dense tufts or cushions, dark to yellow-green; terricolous or saxicolous. *Stems* 30–40 mm high, branching above, radiculose below, dark red; in section round, central strand absent, cortical cells lax, smaller toward margin, outer cortical cells in 2–3 rows, strongly thickened, reddish. *Leaves* incurved to appressed, weakly twisted dry, erect-spreading wet, tips fragile; linear-lanceolate, 5–6 mm long; bistratose above; ventral surface flat; apex subulate, frequently broken above; base ovate to oblong; margins plane, entire, bordered above by single row of smooth, incrassate rectangular cells. *Costa* strong, excurrent, ventral superficial cells quadrate, papillose below, long-rectangular, smooth above, dorsal superficial cells narrowly rectangular, smooth through-

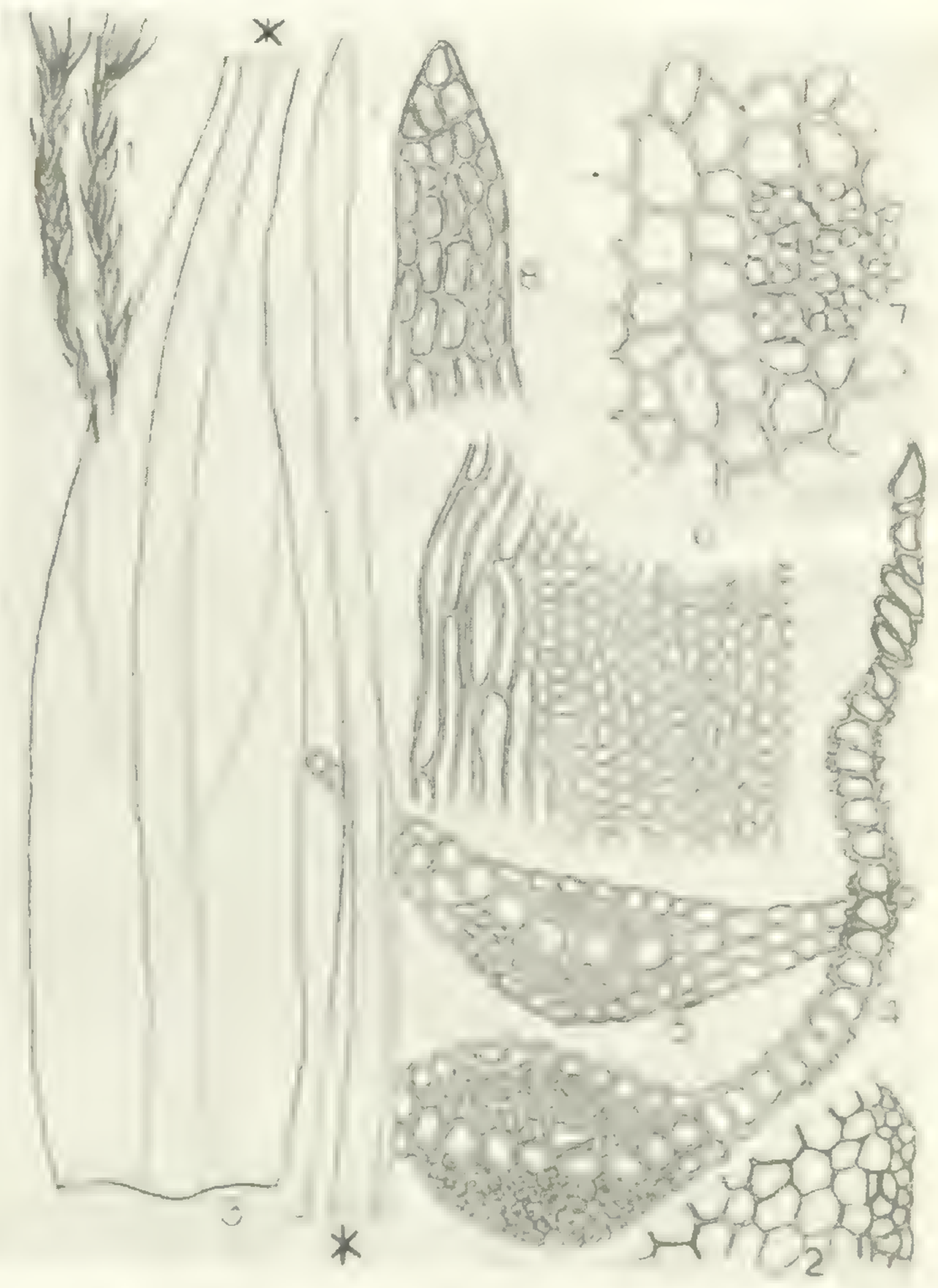


FIG. 76.—**Tortella fragilis: 1.** habit, ×1; **2.** stem in cross section, ×170; **3.** leaf, ×30; **4.** leaf in proximal cross section, ×220; **5.** leaf in distal cross section, ×220; **6.** laminal cells at mid-leaf showing larger basal cells extending up left margin, ×170; **7.** upper laminal cells (papillae partly shown), ×640; **8.** leaf apex, ×170. (1–8, *Magill* 4408).

out; in section semicircular, guide cells 8–10, occasionally with 1–2 cells above or below main layer, ventral stereid band strong, to 5 cells thick, ventral surface cells similar to laminal cells, papillose in lower leaf, smooth above, dorsal stereid band strong, 6–8 cells thick, surface cells not differentiated or 1–2 cells at insertion of lamina larger, incrassate, papillose. *Upper laminal cells* rounded, quadrate to short-rectangular, incrassate, papillae low, massive, mostly 4, completely covering cells in upper leaf; marginal cells in 1–3 rows, rectangular, incrassate, smooth; basal cells rectangular, lax, hyaline, smooth, extending up margin, confined to lower ⅓ or ending below mid-leaf.

Sporophytes unknown. Fig. 76: 1–8.

Although *T. fragilis* occurs throughout the Northern Hemisphere it has not been reported previously for the Southern Hemisphere. The Southern African plants were collected above 2 700 m in the mountains of eastern Lesotho. Map 99.

Vouchers: *Magill* 4341, 4408.

The long, rigid, fragile leaf tip, bistratose upper leaf and large size of the plants distinguish *T. fragilis* from other species of *Tortella*. The phytogeographic importance of eastern Lesotho is again demonstrated by the presence of this Northern Hemisphere species at high elevations in the Drakensberg.

5. OXYSTEGUS

Oxystegus (*Limpr.*) *Hilp.* in Beih. bot. Zbl. 50: 666 (1933); Saito in J. Hattori bot. Lab. 39: 436 (1975); Gangulee, Moss. E. India 653 (1972). Lectotype species: *O. cylindricus* (Brid.) Hilp.

Plants small to medium, yellow-green; saxicolous or terricolous. *Stems* without central strand. *Leaves* linear-lanceolate to ligulate, fragile; apex acute; margins plane, entire. *Laminal cells* quadrate to short-rectangular, papillose; basal cells lax, smooth.

Sporophyte terminal; capsule cylindrical; peristome teeth filiform, erect, distant, without basal membrane.

Thirteen species of *Oxystegus* are known, primarily from southern Asia, Africa and South America. *Oxystegus cylindricus* occurs throughout the Northern Hemisphere. The genus is recognized by the absence of a central strand of the stem, narrow, fragile leaves with plane margin, a costa with dorsal and ventral stereid bands, and a peristome without a basal membrane.

Oxystegus cylindricus (*Brid.*) *Hilp.* in Beih. bot. Zbl. 50: 620 (1933); Saito in J. Hattori bot. Lab. 39: 437 (1975). Type: Europe.

Weissia cylindrica Bruch ex Brid., Bryol. Univ. 1: 806 (1827). *Trichostomum cylindricum* (Brid.) C. Müll., Syn. Musc. 1: 586 (1849), non Hedwig (1801); Sim, Bryo. S. Afr. 245 (1926).

Barbula leptotortella C. Müll. in Hedwigia 38: 110 (1899). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n.

Plants small to medium, loosely caespitose, yellow-green; terricolous or saxicolous. *Stems* 5–10 mm high, occasionally branched above; in section round, central strand absent, cortical cells incrassate, smaller toward margin; axillary hair long, to 20 cells, hyaline throughout. *Leaves* crowded above, incurved, contorted to spirally twisted dry, erect-spreading wet, frequently fragile or broken; linear-lanceolate or narrowly ligulate, 2,5–4,5 mm long; apex acute to narrowly acuminate; margins plane, entire. *Costa* percurrent to short-excurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells narrowly rectangular, smooth; in section semicircular, guide cells 4–5, ventral stereid band strong, 2–3 cells thick, ventral surface cells small, similar to laminal cells, dorsal stereid band 2–4 cells thick, dorsal surface cells undifferentiated or substereids. *Upper laminal cells* quadrate to short-rectangular, incrassate, papillae low, blunt, 4–8 over lumen; basal cells rectangular, hyaline, smooth, thin-walled, junction with laminal cells straight across leaf or occasionally extending a short distance up margin.

Dioicous. Perichaetia terminal, leaves short, base broader than vegetative leaves. *Seta* 6–8 mm long, yellow; capsule cylindrical, 2 mm long, reddish yellow; peristome

variable, erect or weakly twisted, teeth filiform, occasionally perforated or divided above, papillose; operculum long-rostrate, 0,8 mm long; calyptra cucullate, 2 mm long; spores round, 8–12 μm, granulate. Fig. 77: 1–10.

Oxystegus cylindricus is almost cosmopolitan in distribution, absent only from Australasia, Australia, New Zealand and Antarctica. In Southern Africa, plants are uncommon. They occur in Natal and in scattered localities in the eastern and southwestern Cape Province. Map 98.

Vouchers: *Magill* 3802, 3980, 5605; *Owen* 17; *Sim* 10067.

Although some plants of *O. cylindricus* approach *Trichostomum brachydontium* in habit and leaf shape (see note under that species), the presence or absence of the central strand in the stem is reliable in separating similar specimens. Most specimens of *O. cylindricus* have the typical narrow, often fragile leaves, and a more open appearance with incurled, twisted leaves when dry. In addition, *O. cylindricus* has a well developed peristome, while in Southern African specimens of *T. brachydontium* peristomes are rudimentary or absent.

6. TRICHOSTOMUM

Trichostomum *Bruch* in Flora, Jena 12: 295 (1829); Saito in J. Hattori bot. Lab. 39: 431 (1975); Gangulee, Moss. E. India 675 (1972). Type species: *T. brachydontium* Bruch.

Plants short to tall, dark green to yellow-green; saxicolous or terricolous. *Stems* with well-developed central strand. *Leaves* narrowly spathulate to elliptical; apex broad; margins plane, entire. *Laminal cells* quadrate to subquadrate, densely papillose; basal cells lax, smooth.

Sporophyte terminal; capsule short-cylindrical; peristome present, absent or rudimentary, when developed with basal membrane.

The 106 species of *Trichostomum* are equally distributed throughout the world. The genus is recognized by the presence of a central strand in the stem, broad leaves with plane margins, short-excurrent costa with dorsal and ventral stereid bands, and a peristome, with erect teeth from a short basal membrane, which is frequently rudimentary or absent.

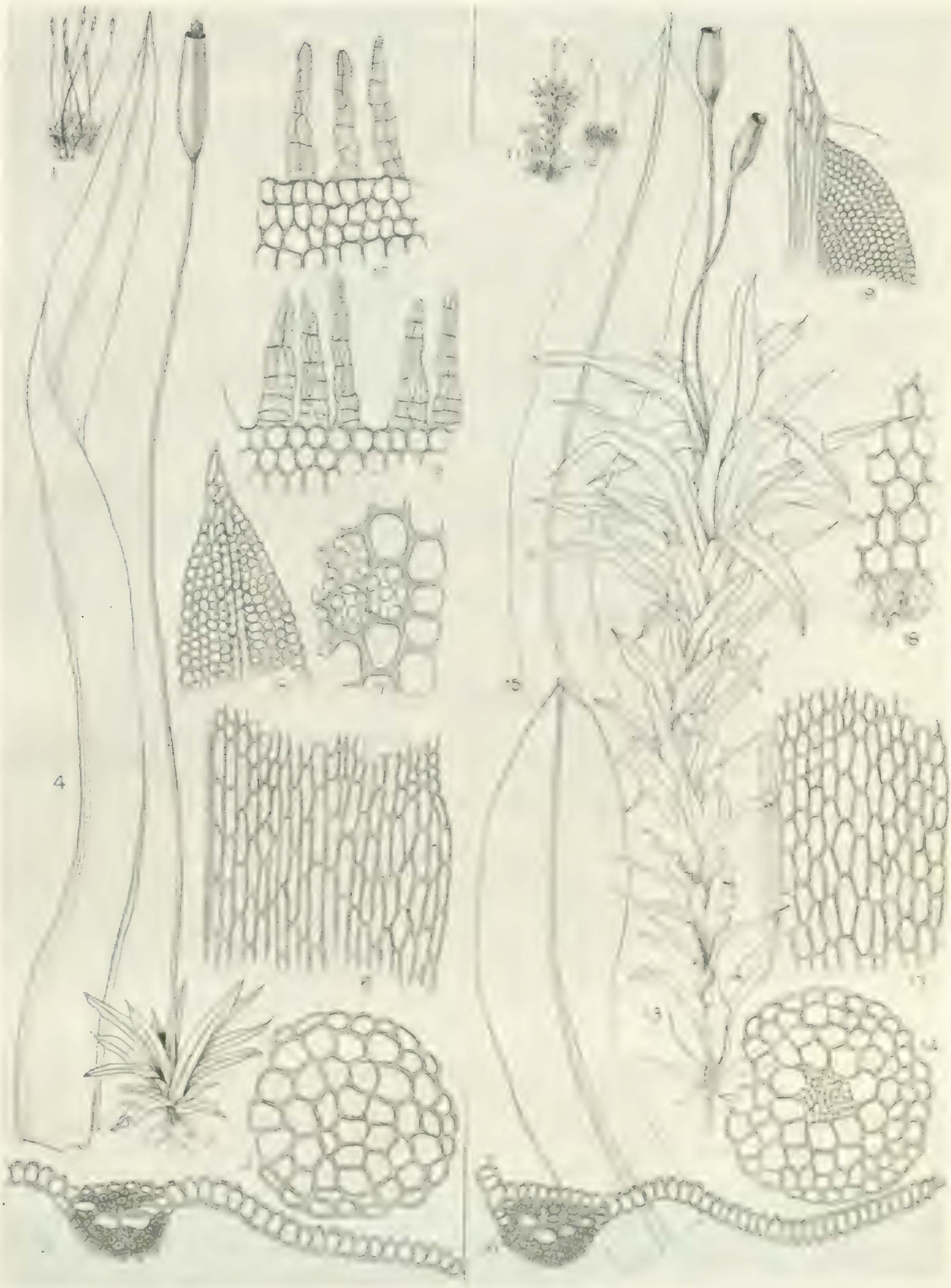
Trichostomum brachydontium *Bruch ex F. A. Muell.* in Flora, Jena 12: 393 (1829); Saito in J. Hattori bot. Lab. 39: 431 (1975); Smith, Moss Fl. Brit. Irel. 291 (1978); Sim, p.p., Bryo. S. Afr. 242 (1926). Type: Europe.

Pottia zeyheri Hampe ex C. Müll., Syn. Musc. 1: 561 (1849). *Hyophila zeyheri* (Hampe) Jaeg. in Verh. St Gall. naturw. Ges. 1871–72: 355 (1873); Sim, Bryo. S. Afr. 221 (1926). Type: Cape, *Zeyher* s.n. (BM!).

Pottia afrophaea C. Müll. in Hedwigia 38: 97 (1899); Sim, Bryo. S. Afr. 219 (1926). *Hyophila afrophaea* (C. Müll.) Warnst. in Hedwigia 58: 59 (1916). Type: Orange Free State, Bethlehem, *Rehmann* 120 (PRE!).

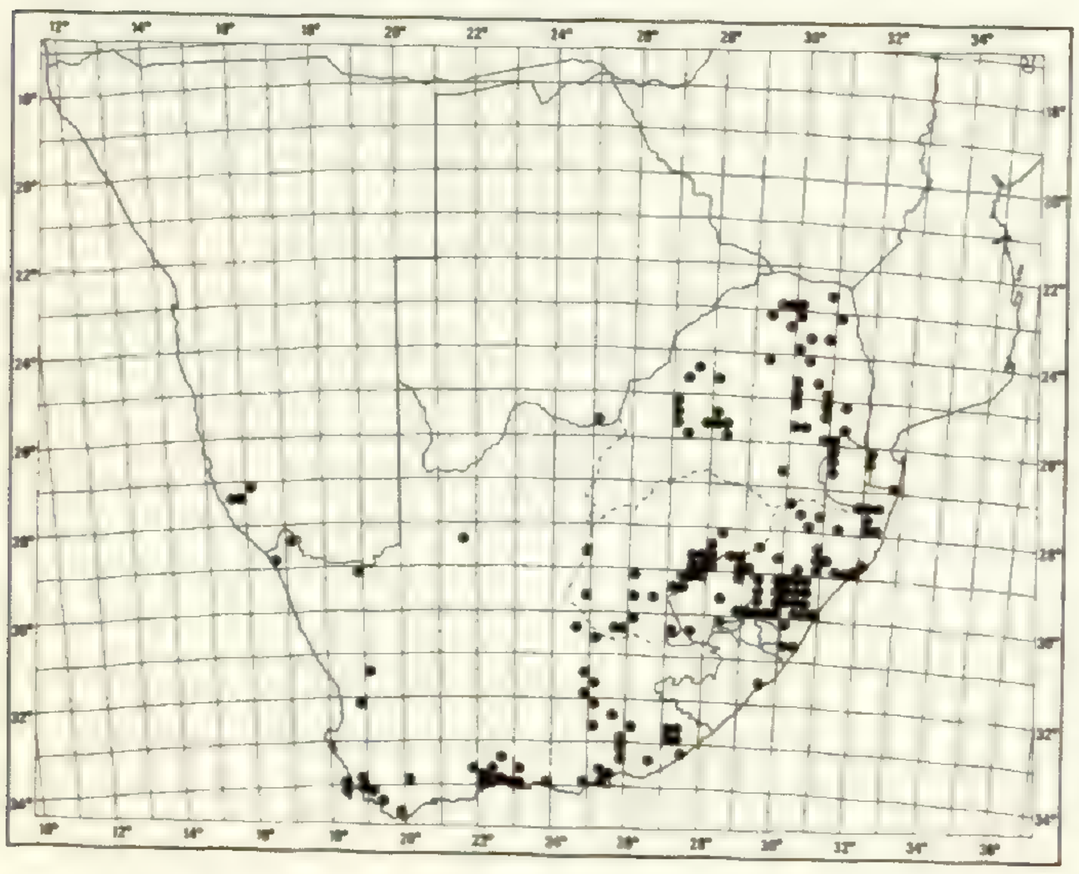
Plants medium-sized, caespitose, dark green to yellow-green; terricolous or saxicolous. *Stems* 4–26 mm tall; in section round, central strand present, frequently large, cortical cells ± incrassate, smaller toward margin, occasionally stereids; axillary hairs 8–12 cells long, hyaline throughout. *Leaves* incurved, appressed to crisped dry, widely spreading wet; narrowly spathulate to elliptical or oblong, 2,5–3,5 mm long; apex broadly acute to obtuse, cuspidate; margins plane, entire. *Costa* short-excurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells rectangular, smooth; in section semicircular to subround, guide cells 4, ventral stereid band strong, 2–3 cells thick, ventral surface cells similar to laminal cells, dorsal stereid band strong, 3–4 cells thick, dorsal surface cells substereids or differentiated only at insertion of lamina.

FIG. 77.—**Oxystegius cylindricus** (1–10): **1.** habit, ×1; **2.** habit, ×8; **3.** stem in cross section, ×170; **4.** leaf, ×40; **5.** leaf in cross section, ×130; **6.** cells at leaf base (right side), ×170; **7.** upper laminal cells (papillae partly shown), ×640; **8.** leaf apex, ×170; **9–10.** parts of capsule mouth with peristome teeth, ×170. **Trichostomum brachydontium** (11–19): **11–12.** habit, ×1; **13.** habit, ×8; **14.** stem in cross section, ×170; **15.** leaves, ×40; **16.** leaf in cross section, ×130; **17.** cells at leaf base (right side), ×170; **18.** upper laminal cells (papillae partly shown), ×640; **19.** leaf apex (dorsal surface), ×170. (1–10, *Magill* 3980; 11 & 13–19, *Sim* 8579; 12, *Smook* 944).



Upper laminal cells quadrate to subquadrate, incrassate, papillae numerous, low, blunt, scattered over lumen; marginal cells generally papillose; basal cells rectangular, hyaline, smooth, thin-walled, junction with laminal cells ± straight across leaf.

Dioicous. Perichaetia terminal, leaves undifferentiated. *Seta* 5–10 mm long, yellowish; capsule short-cylindrical, 1,5 mm long; peristome absent or rudimentary; operculum rostrate, 1 mm long; calyptra cucullate; spores round, 15–17 μm, papillose. Fig. 77: 11–19.



MAP 101.— ● **Trichostomum brachydontium**

A cosmopolitan species, *T. brachydontium* is also widespread in Southern Africa and found in a large variety of habitats. Map 101.

Vouchers: *Crosby & Crosby* 7699; *Hardy* 5192; *Lavranos* 15204a; *Magill* 4545a, 5447, 6048; *Rankin* 12; *Retief* 360a; *Vahrmeijer* PRE-CH12674; *Van Rooy* 56, 269.

A degree of variability is expressed by *T. brachydontium* in Southern Africa. The specimens generally reflect differences in habitat through stature of the plants. The leaves also vary in size and to some degree shape, but plants from desert or forest are recognized by the narrowly spathulate or elliptical leaves with broad apices. In Southern African specimens the peristome is absent or rudimentary, a condition also known from South American specimens. Northern Hemisphere specimens generally have short, fragile teeth.

Insufficiently Known Species

Trichostomum leiodontium C. Müll. in Hedwigia 38: 100 (1899). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n. The type has not been seen. Brotherus in Natürl. PflFam. 1: 397 (1902) considered this species a synonym of *Tortella xanthocarpa* (C. Müll.) Broth.

7. WEISSIA

Weissia *Hedw.*, Spec. Musc. 64 (1801); Saito in J. Hattori bot. Lab. 39: 417 (1975); Smith, Moss Fl. Brit. Irel. 274 (1978). Type species: *W. controversa* Hedw.

Hymenostomum R. Br. in Trans. Linn. Soc. Lond. 12: 572 (1819); Sim, Bryo. S. Afr. 254 (1926). Type species: *H. microstomum* (Hedw.) R. Br.

Plants small, in loose tufts, green to yellow-green; terricolous. *Stems* short; central strand present. *Leaves* larger above, incurved-contorted or twisted above base when dry, spreading wet, narrow; linear, lanceolate or oblong; apex acute to obtuse, frequently cucullate, mucronate to apiculate; margins involute to incurved. *Costa* short-excurrent, rarely percurrent in some leaves, ventral superficial cells quadrate, papillose, frequently patchy, rarely absent; in section with dorsal and ventral stereid bands. *Laminal cells* quadrate, weakly thickened, papillose, occasionally papillae on dorsal and ventral surfaces differing.

Autoicous or paroicous (? dioicous). Perichaetial leaves little differentiated, somewhat longer. *Seta* erect, yellowish; capsule cylindrical; peristome present, rudimentary or absent, capsule occasionally hymenostomaceous; operculum rostrate, cells not twisted; calyptra cucullate; spores round, papillose.

The genus *Weissia*, as circumscribed here, comprises the species included by some authors in *Hymenostomum*. The division lines between capsules that are either hymenostomaceous or gymnostomaceous and those producing a rudimentary or complete peristome is not altogether clear, and reliable gametophytic characters are not always available. Therefore all species present in Southern Africa are treated under *Weissia*, and the genus is divided into the subgenera *Weissia* and *Hymenostomum*.

The genus *Weissia* consists of c. 88 species found throughout the world. A few species, such as *W. controversa*, are widespread to cosmopolitan, but the great majority of species is very restricted or even local in distribution. This is the case with the Southern African species. A broader revision and more realistic interpretation of sporophyte and peristome development will no doubt greatly reduce the number of species presently recognized in the genus.

1 Peristome present, occasionally very rudimentary (subgen. *Weissia*):
  2 Plants paroicous; peristome teeth linear, distant; leaves to 2 mm long; costa percurrent to very short-excurrent ..... 1. *W. dieterlenii*
  2 Plants autoicous; peristome teeth lanceolate, frequently irregularly cleft or perforated; leaves to 4 mm long; costa short-excurrent ..... 2. *W. controversa*
1 Peristome absent (subgen. *Hymenostomum*):
  3 Leaves linear-lanceolate, 3–4 mm long; costa apiculate ..... 3. *W. humicola*
  3 Leaves to 2 mm long; costa percurrent to mucronate:
    4 Leaves narrowly lanceolate; ventral superficial costal cells elongate, smooth throughout .. 4. *W. cucullata*
    4 Leaves oblong to narrowly oval; ventral superficial costal cells quadrate, papillose ..... 5. *W. latiuscula*

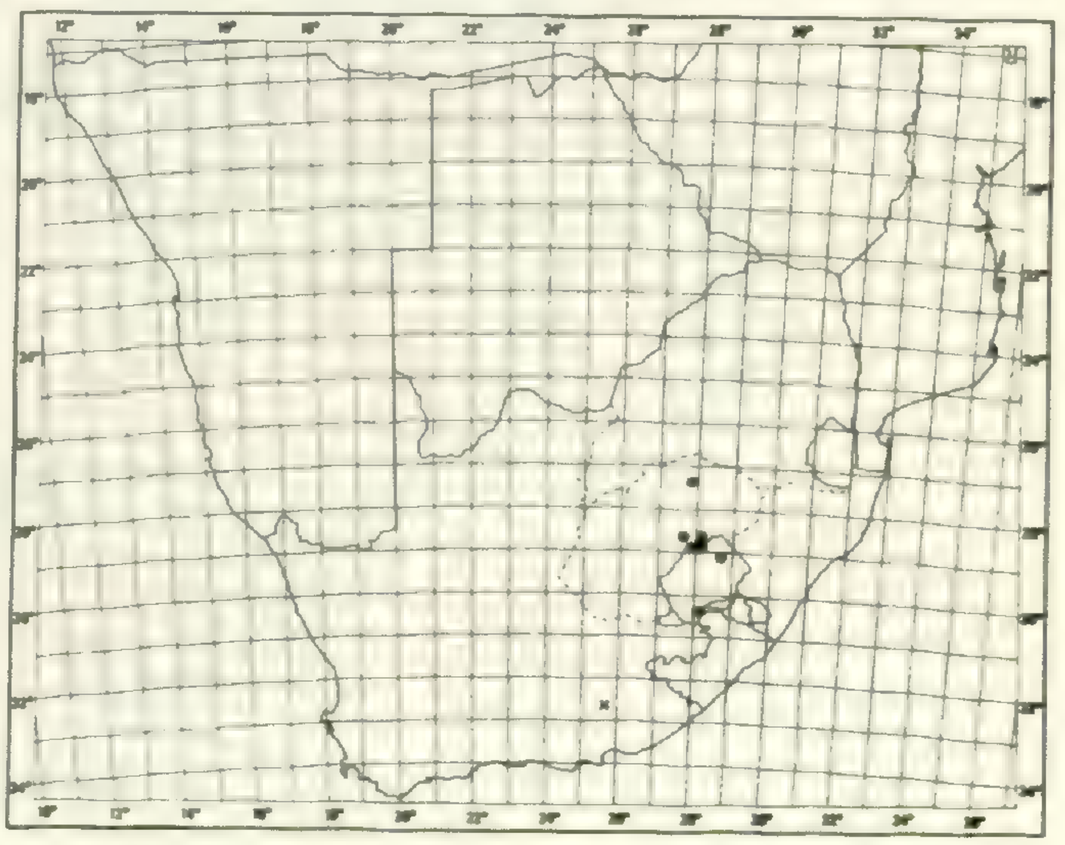
1. **Weissia dieterlenii** *Thér.* in Bull. Mus. Hist. nat., Paris 30: 240 (1924); Broth. in Natürl. PflFam. 10: 255 (1924). Type: Lesotho, Leribe, *Dieterlen* s.n. (PC, holo.!; PRE!; NH!).

Weissia brachycarpa C. Müll. in Hedwigia 38: 112 (1899), hom. illeg., non (Nees & Hornsch.) Jur. (1882). *Hymenostomum brachycarpum* (C. Müll.) Par., Ind. Bryol. Suppl. 189 (1900); Broth. in Natürl. PflFam. 10: 254 (1924). *Weissia viridula* Hedw. var. *brachycarpa* (C. Müll.) Dix. in Trans. R. Soc. S. Afr. 18: 251 (1929) [excluding *Wager* 988; *Pillans* 4748], non *Weissia viridula* Hedw. var. *brachycarpa* Nees & Hornsch. (1831). *Weissia controversa* var. *pillansii* Schelpe in Trans. R. Soc. S. Afr. 44: 116 (1979). Type: Orange Free State, Renoster River, *Rehmann* s.n., Herb. Jack (G. holo.!).

Plants small, loosely caespitose, yellow-green; terricolous. *Stems* 2–4 mm tall; in section round, central strand large, inner cortical cells large, in single row, outer cortical cells in 2–3 rows, smaller. *Leaves* spirally twisted dry, erect-spreading wet; lanceolate, 1,5–2,0 mm long; apex acute, mucronate, frequently obtuse in lower leaves; base oval to oblong; margins narrowly involute, entire. *Costa* percurrent to very short-excurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells rectangular, smooth; in section round, guide cells 2, ventral stereid band of 1–2 cells only, ventral surface cells similar to laminal cells, dorsal stereid band 2–3 cells thick, occasionally substereids. *Upper laminal cells* quadrate to subquadrate or angular, weakly incrassate, superficially bulging on both surfaces, papillae low and simple; basal cells rectangular, hyaline, smooth, thin-walled.

Paroicous. Antheridia in upper leaf axils; perichaetia terminal, leaves undifferentiated. *Seta* 6–7 mm long, yellow; capsule short-cylindrical, 1,2 mm long, reddish yellow; peristome present, inserted below mouth, teeth linear, distant, 120 μm high, erect, red-yellow, weakly papillose; operculum rostrate, 0,8 mm long; spores subround to angular, (12–) 15–17 μm, irregularly papillose. Fig. 78: 1–12.

Endemic to Southern Africa, *W. dieterlenii* is known from grasslands of Lesotho and the Orange Free State. Map 102.



MAP 102.— ● **Weissia dieterlenii**
× **Weissia humicola**

Voucher: *Magill* 4679; *Van Rooy* 366, 432.

Specimens of *W. dieterlenii* bear some resemblance to *W. controversa*, but the paroicous condition and distinctive peristome will easily separate the two species. See note on *W. brachycarpa* under *W. humicola*.

2. **Weissia controversa** *Hedw.*, Spec. Musc. 67 (1801); Saito in J. Hattori bot. Lab. 39: 426 (1975); Smith, Moss Fl. Brit. Irel. 276 (1978). Type: Europe.

Weissia viridula Hedw. ex Brid., hom. illeg., Bryol. Univ. 1: 364 (1826); Broth. in Natürl. PflFam. 10: 255 (1924); Sim, Bryo. S. Afr. 253 (1926).

?*Weissia linguaelata* Shaw in Cape Monthly Mag. 17: 378 (1878). Type: Cape, Graaff-Reinet, *McLea* s.n.

Weissia vallis-gratiae C. Müll. in Hedwigia 38: 111 (1899); Broth. in Natürl. PflFam. 10: 255 (1924). Type: Cape, Gnadenthal, *Breutel* s.n. Herb. Hampe (BM, holo.!).

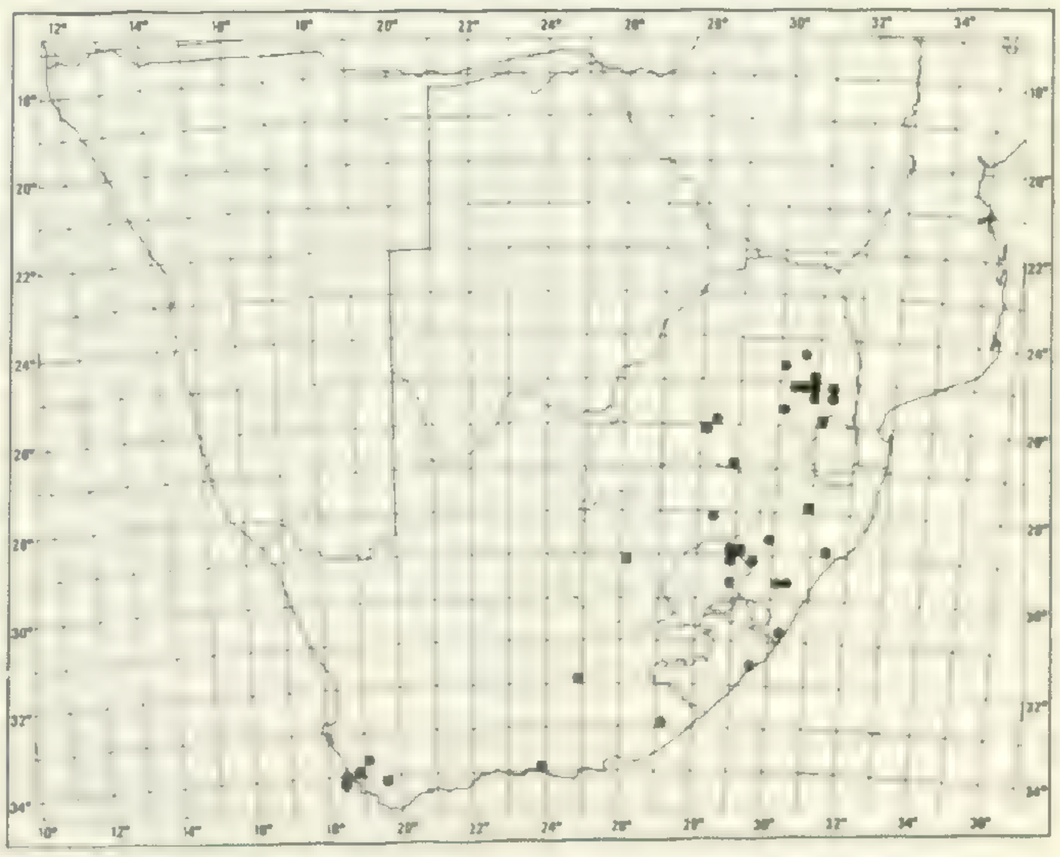
Weissia oranica C. Müll. in Hedwigia 33: 112 (1899); Broth. in Natürl. PflFam. 10: 255 (1924). Type: Orange Free State, 'Blumfontein', *Rehmann* 19 (BM!; PRE!).

Weissia viridula Hedw. var. *longifolia* Broth. & Wag. in Trans. R. Soc. S. Afr. 4: 6 (1914); Sim, Bryo. S. Afr. 253 (1926).

Plants small, loosely caespitose, green to yellow-green; terricolous. *Stems* 2–4 mm high, infrequently branched below; in section round, central strand present, occasionally large, inner cortical cells large, slightly thickened, outer cells smaller. *Leaves* twisted to spirally involute dry, widely spreading wet; lanceolate to linear-lanceolate, 2–4(–5) mm long; apex acute, apiculate; base ovate to oblong; margins narrowly involute, entire. *Costa* short-excurrent, ventral superficial cells quadrate, papillose, frequently patchy, exposing smooth, rectangular cells, dorsal superficial cells long-rectangular, smooth; in section round, guide cells 4, ventral stereid band 1–2 cells thick, ventral surface cells large, papillose, dorsal stereid band 2–3 cells thick, dorsal surface cells undifferentiated, smooth. *Upper laminal cells* quadrate to rounded, thickened, papillae low, numerous, scattered over lumen, dorsal surface occasionally strongly thickened, obscuring papillae; basal cells rectangular, hyaline, smooth.

Autoicous. Perigonia on short lateral branches; perichaetia terminal, leaves similar to vegetative leaves, frequently longer. *Seta* (4–) 6–8 mm long, yellow; capsule short-cylindrical, 1,5 mm long, reddish yellow, mouth red; peristome short, inserted below mouth, teeth lanceolate, obtuse, frequently cleft or perforated, occasionally rudimentary, 150–200 μm high, reddish, papillose; operculum rostrate, 0,5–0,6 mm long; spores round, 20–22 μm, strongly papillose. Fig. 78: 13–23.

Weissia controversa is a cosmopolitan species frequently collected in eastern and southern parts of Southern Africa. The small moss is common in city gardens as well as natural habitats. Map 103.



MAP 103.— ● **Weissia controversa**

Vouchers: *Cholnoky* 792; *Esterhuysen* 15532; *Eyles* 1412; *Magill* 5871; *Schelpe* 7843; *Wager* 1447.

The long, narrow leaves with strongly involute margins distinguish *W. controversa* from most other mosses. The short, somewhat fragile peristome may appear absent in older capsules but careful observation generally reveals basal fragments of the peristome within the capsule mouth. *Weissia humicola* and *W. dieterlenii* are both gametophytically similar to *W. controversa* and identification is difficult without capsules.

FIG. 78.—**Weissia dieterlenii** (1–12): **1.** habit, ×1; **2.** habit, ×20; **3.** stem in cross section, ×340; **4–5.** leaves, ×40; **6.** leaf in cross section, ×640; **7.** cells at leaf base (left side), ×170; **8.** upper laminal cells (papillae partly shown), ×640; **9.** leaf apex, ×170; **10.** perichaetial leaf with attached antheridium, ×40; **11.** part of capsule mouth with peristome teeth and spores, ×170; **12.** spore, ×640. **W. controversa** (13–23): **13.** habit, ×1; **14.** habit, ×20; **15–16.** leaves, ×40; **17.** leaf in cross section, ×640; **18.** cells at leaf base (right side), ×170; **19.** upper lamina cells (papillae partly shown), ×640; **20.** leaf apex, ×170; **21.** perigonium, ×75; **22–23.** parts of capsule mouth with peristome teeth, ×170. **W. humicola** (24–32): **24.** habit, ×1; **25.** habit, ×10; **26.** leaves, ×40; **27.** leaf in cross section, ×640; **28.** cells at leaf base (right side), ×170; **29.** upper laminal cells (papillae partly shown), ×640; **30.** leaf apex, ×170; **31.** part of capsule mouth, ×170; **32.** spore, ×640. (1–12, *Dieterlen* s n.; 13–22, *Sim* 9180; 23, *Eyles* 1412; 24–32, *J. Sim* PRE-CH7846).

3. **Weissia humicola** *C. Müll.* in Hedwigia 38: 112 (1899). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n., 1876.

Hymenostomum humicola (C. Müll.) Par., Ind. Bryol. Suppl. 189 (1900); Broth. in Natürl. PflFam. 10: 254 (1924); Sim, Bryo. S. Afr. 254 (1926).

Weissia viridula Hedw. var. *brachycarpa* sensu Dixon in Trans R. Soc. S. Afr. 18: 251 (1929).

Plants small, loosely caespitose, yellow-green; terricolous. *Stems* 2–5 mm tall, branching below; in section round, central strand present, cortical cells variable in size, incrassate. *Leaves* contorted to incurved dry, widely spreading wet; linear-lanceolate, 3–4 mm long; apex acute, apiculate; base oblong; margins narrowly incurved to involute, entire. *Costa* short-excurrent, ventral superficial cells quadrate, papillose, occasionally patchy, exposing smooth, rectangular cells, dorsal superficial cells long-rectangular, smooth; in section subround, guide cells 2–4, ventral stereid band weak, of 1–2 cells only, ventral surface cells similar to laminal cells, papillose or stereids exposed, smooth, dorsal stereid band 2–3 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* quadrate, thickened, papillae low, numerous, scattered over lumen; basal cells rectangular, hyaline, smooth, thin-walled.

?Dioicous. Perigonia not seen; perichaetia terminal, leaves similar to vegetative leaves, but slightly longer. *Seta* 4–5 mm long, yellow; capsule short-cylindrical, 1 mm long, yellowish; peristome absent; operculum rostrate, 0,5–0,6 mm long; spores round, 17–20 μm, strongly papillose. Fig. 78: 24–32.

Endemic to Southern Africa, *W. humicola* is known only from shrublands of the eastern Cape Province. Map 102.

Vouchers: *MacOwan* 22; *J. Sim* PRE-CH7846.

Specimens of *W. humicola* are very similar to *W. controversa* and may represent a gymnostomous form of that species, since the capsules examined were not hymenostomaceous. The present taxonomic trend is to separate such taxa into different species and this is followed here. Both species generally produce numerous sporophytes, so that identification is possible. Specimens of *W. controversa* with rudimentary peristomes could easily be mistaken for this species.

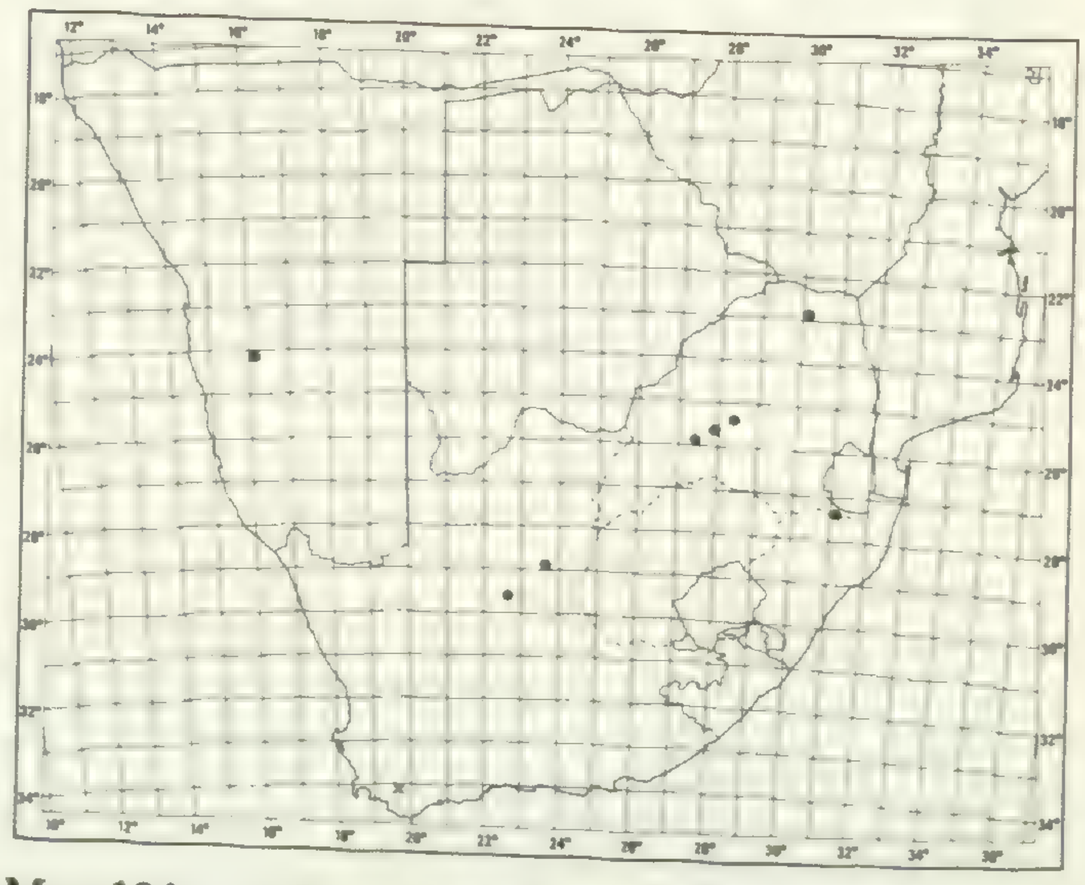
The specimens (*Wager* 988; *Pillans* 4748) cited by Dixon (1929) when he made the combination *W. viridula* var. *brachycarpa* (C. Müll.) Dix. are, on the basis of gymnostomous capsules, best placed here. The type on which the name is based (*Rehmann* s.n., Herb. Jack, G!) has a distinctive peristome and has been referred to *W. dieterlenii* Thér.

4. **Weissia cucullata** *C. Müll.* in Bot. Ztg 16: 163 (1958). Type: Cape, Gnadenthal, *Breutel* s.n., Herb. Hampe (BM, holo.!).

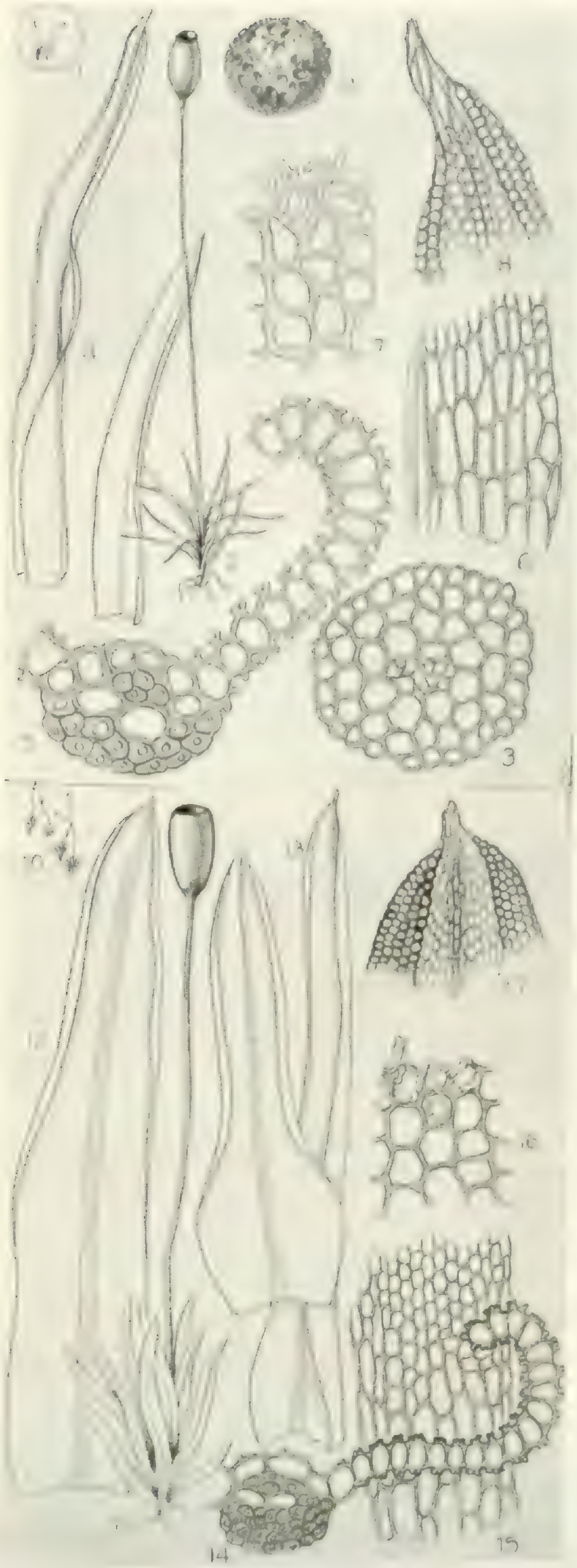
Hymenostomum cucullatum (C. Müll.) Kindb., Enum. Bryin. Exot. 62 (1888); Broth. in Natürl. PflFam. 10: 254 (1924).

Plants small, loosely caespitose, yellow-green; terricolous. *Stems* 2–4 mm tall, occasionally branched below; in section round, central strand small, cortical cells incrassate, outer row smaller. *Leaves* contorted-incurved dry, erect-spreading wet; linear-lanceolate, to 2 mm long; apex acute, weakly cucullate, mucronate; base oblong; margins narrowly incurved, entire. *Costa* short-excurrent, ventral superficial cells elongate, smooth, dorsal superficial cells long-rectangular, smooth; in section oval, guide cells 4, ventral stereid band strong, 2–3 cells thick, ventral surface cells undifferentiated, dorsal stereid band 3–4 cells thick, dorsal surface cells undifferentiated. *Upper laminal cells* quadrate, thin-walled, papillae on ventral surface large, branched, 1–2 over lumen, on dorsal surface low, numerous, scattered; basal cells rectangular, hyaline, smooth, thin-walled.

Autoicous. Perichaetia terminal, leaves similar to vegetative leaves, but slightly larger. *Seta* 2–3 mm long, yellow; capsule hymenostomaceous, oval, constricted at mouth, 0,8–1,0 mm long, reddish yellow; peristome absent; operculum rostrate, 0,3–



MAP 104.— ● **Weissia latiuscula**
× **Weissia cucullata**



0,4 mm long; spores round, 25 μm, strongly papillose. Fig. 79: 1–9.

Endemic to Southern Africa, this species is known only from the type specimen. The original collection was made by Breutel, in the mountains near the mission station at Gnadenthal, in the south-western Cape. Map 104.

Voucher: Type only.

The small, linear-lanceolate leaves, acute-cucullate apices and hymenostomaceous capsules help to identify *W. cucullata*. The spores are also larger than those of any other Southern African species of *Weissia*.

5. **Weissia latiuscula** *C. Müll.* in Hedwigia 38: 111 (1899). Type: Transvaal, Lydenburg, *Wilms* s.n., 1887 (G, holo.!).

Hymenostomum latiusculum (C. Müll.) Par., Ind. Bryol. Suppl. 189 (1900); Broth. in Natürl. PflFam. 10: 254 (1924).

Hymenostomum eurybasis Dix. in S. Afr. J. Sci. 18: 333 (1922); Sim, Bryo. S. Afr. 255 (1926). Syntypes: Zimbabwe, Matopos, *Eyles* 940, 941; Magude, *Sim* 8989.

Plants small, loosely caespitose, light green to yellow-green; terricolous or saxicolous. *Stems* 2–4 mm high, branching below; in section round, central strand large or small, cortical cells lax, outer 1–2 rows smaller. *Leaves* closely incurved dry, widely spreading wet; oblong to narrowly oval, 1,8–2,5 mm long, upper and subperichaetial leaves linear; apex rounded-obtuse, cucullate, mucronate; base oblong; margins broadly incurved, entire. *Costa* percurrent to short-excurrent, ventral superficial cells quadrate, papillose, dorsal superficial cells rectangular, smooth; in section round, guide cells 2–4, ventral stereid band 2–3 cells thick, ventral surface cells similar to laminal cells, papillose, dorsal stereid band 4 cells thick, dorsal surface cells undifferentiated, smooth. *Upper laminal cells* quadrate to subquadrate, ventral surface bulging, papillae numerous,

FIG. 79.—**Weissia cucullata** (1–9): **1.** habit, ×1; **2.** habit, ×10; **3.** stem in cross section, ×275; **4.** leaves, ×40; **5.** leaf in cross section, ×530; **6.** cells at leaf base, ×170; **7.** upper laminal cells (papillae partly shown), ×640; **8.** leaf apex, ×170; **9.** spore, ×640. **W. latiuscula** (10–17): **10.** habit, ×1; **11.** habit, ×10; **12–13.** leaves, ×40; **14.** leaf in cross section, ×340; **15.** basal leaf cells at right margin, ×170; **16.** upper laminal cells (papillae partly shown), ×640; **17.** leaf apex, ×170. (1–9, *Breutel* s.n.; 10–17, *Smook & Harding* 705a).

low, simple or raised on incrassate mammillae, dorsal surface flat, papillae numerous, low, simple; basal cells rectangular, hyaline, smooth, thin-walled.

Autoicous. Perigonia on short lateral branches; perichaetia terminal, leaves linear, acute. *Seta* to 4 mm long, yellow; capsule cylindrical, 1 mm long, conspicuously constricted below mouth dry, yellowish, mouth red; peristome absent; operculum rostrate, 0,6 mm long; spores round, 20–22 μm, papillose. Fig. 79: 10–17.

In Southern Africa *W. latiuscula* is known from dry shrublands of central South West Africa/Namibia, the northern, central and southeastern Transvaal and northern and central Cape. The species has also been collected in Zimbabwe. Map 104.

Vouchers: *Smook* 72a, 705a; *Wager* 345.

The oblong leaves with obtuse apices and broadly incurved margins distinguish this species from other species of *Weissia* in Southern Africa. The plants generally show considerable variation between sterile and fertile plants. This applies particularly to leaf size and shape. The leaves of sterile plants and lower leaves of fertile plants are oblong-obtuse, while subperichaetial and perichaetial leaves are linear with acute apices.

BRYOBARTRAMIACEAE

Plants small on persistent protonema, in small groups; terricolous. *Stems* erect; central strand absent. *Leaves* larger above, narrow, ligulate to lingulate; apex obtuse in lower leaves to subulate in subperichaetial leaves; margins plane, papillose. *Costa* ending below apex or ending in subula of subperichaetial leaves; in section with dorsal stereid or substereid band. *Upper laminal cells* quadrate to subhexagonal, papillose; basal cells rectangular, smooth.

Paroicous. Perichaetia terminal, leaves linear-lanceolate, subulate. *Seta* short, erect; capsule cleistocarpic, urn globose-apiculate; epigonium persistent; spores large, warty.

BRYOBARTRAMIA

Bryobartramia *Sainsb.* in Bryologist 51: 10 (1948); Scott & Stone, Moss. S. Aust. 220 (1976); Stone in Aust. J. Bot. 25: 141 (1977). Type species: *B. robbinsii* Sainsb.

With characters of the family.

Bryobartramia is a monotypic genus presently known only from Australia and Southern Africa. The genus shows similarities to genera of Pottiaceae and Encalyptaceae, but is recognized as a separate family because of its persistent epigonium. In all other species of mosses the epigonium splits into a lower part, the vaginula, that surrounds the lower seta and foot of the sporophyte and an upper part, the calyptra, that covers the developing capsule. As the seta elongates the calyptra is pushed away from the vaginula. In *Bryobartramia* the epigonium enlarges to accommodate the entire sporophyte without splitting. Release of spores occurs only after the capsule and epigonium deteriorate. The epigonium is known to frequently outlast the capsule.

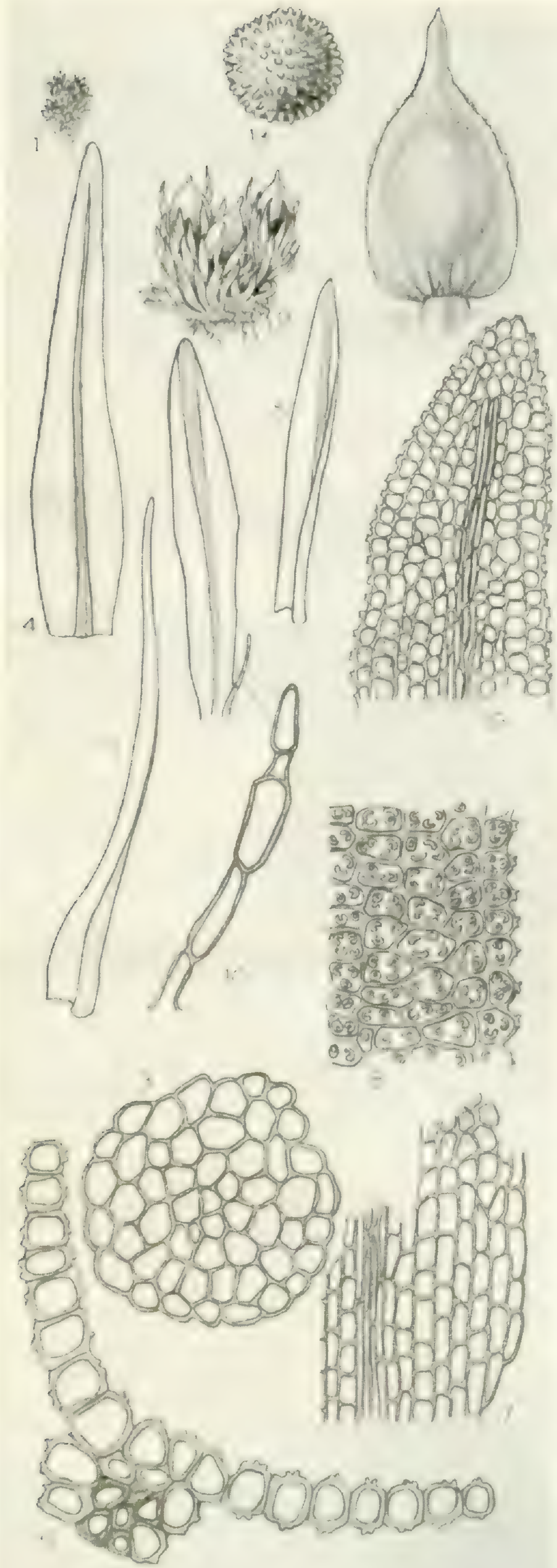
Bryobartramia novae-valesiae (*Broth.*) *Stone & Scott* in J. Bryol. 7: 604 (1973); Stone in Aust. J. Bot. 25: 141 (1977). Type: Australia, New South Wales, Cowra, *Watts* 7829 (NSW).

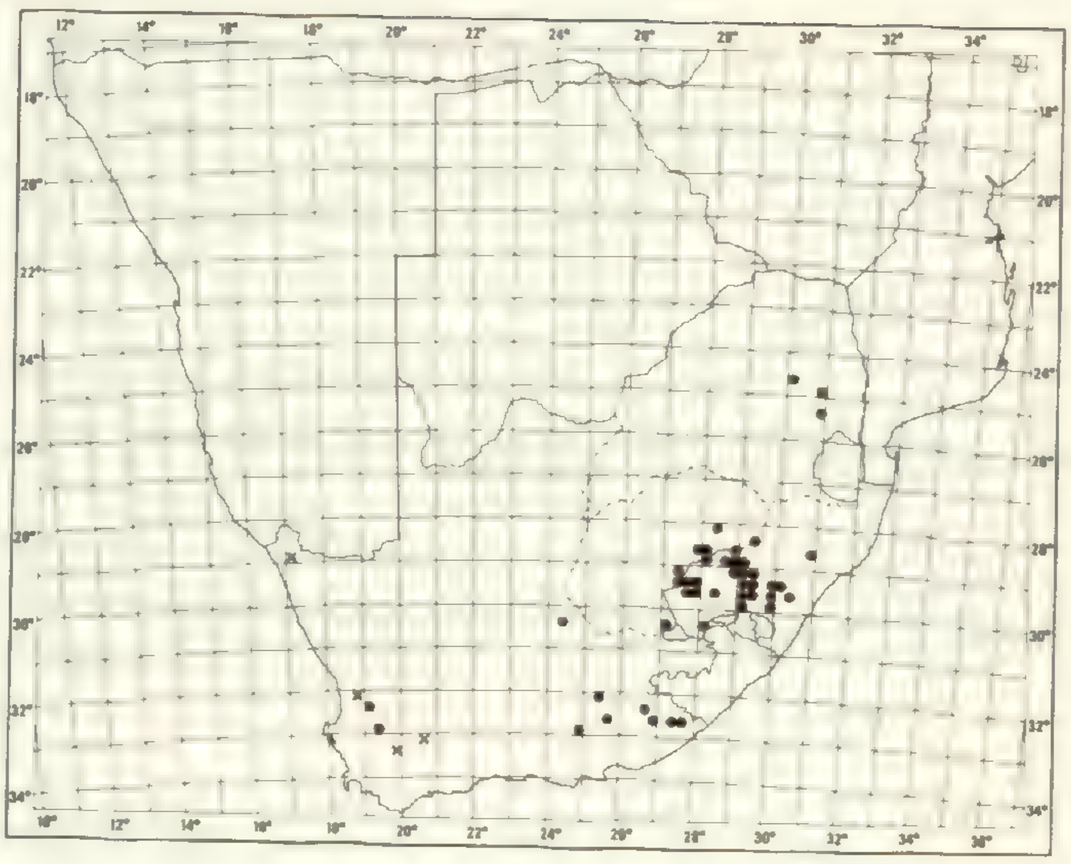
Trachycarpidium novae-valesiae Broth. ex Roth in Hedwigia 53: 94 (1913).

Bryobartramia robbinsii Sainsb. in Bryologist 51: 10 (1948); Stone & Schelpe in Jl S. Afr. Bot. 39: 131 (1973). Type: Australia, Victoria, Castlemaine, *Robbins* s.n., 1941.

Plants small, scattered or in small groups, light green to yellowish with age; terricolous. *Stems* to 3 mm tall, occasionally branched above; in section round, central strand absent, cortical cells thin-walled, in 4 rows, not differentiated. *Leaves* somewhat flexuose above base dry, erect-spreading wet, narrow; lower leaves variable in shape, ligulate to lingulate, 0,3–0,5 mm long; apex obtuse; margins plane, entire or somewhat irregular, costa subpercurrent; upper leaves linear, ligulate, lingulate or lanceolate, 1,0–1,2 mm long; apex broadly acute to obtuse; margins plane, papillose. *Costa* percurrent or ending below apex, weak in leaf base, ventral superficial cells quadrate, papillose, similar to laminal cells, dorsal superficial cells long-rectangular, smooth; in section subround, guide cells 2, incrassate, ventral cells large, in single row, papillose, dorsal stereid or substereid band 2–3 cells thick, frequently exposed, dorsal surface cells large, incrassate, papillose. *Upper laminal cells* quadrate to subhexagonal, weakly thickened, with 2–4 C-shaped papillae over lumen; basal cells rectangular, thin-walled, smooth.

Paroicous. Perichaetia terminal on stem or branches; leaves linear-lanceolate, 1,8–2,0 mm long; apex subulate; margins plane, entire or sparsely denticulate in subula; costa filling subula. *Seta* 0,2–0,4 mm long, red-brown; capsule cleistocarpic, urn globose to oval, apiculate, 0,8 mm long, yellowish; exothecial cells isodiametric, thin-walled, stomata phaneropore, scattered over urn; epigonium persistent, oval-rostrate, 1,7–2,2 mm long, cells below beak prorate; spores subround, 35–40 μm, warty, yellow-brown. Fig. 80: 1–13.





MAP 105.— ● **Grimmia apocarpa**
× **Bryobartramia novae-valesiae**

This species is known from southern Australia and Southern Africa. In the Flora area, *B. novae-valesiae* has been collected only a few times in the western Cape Province. The specimens were collected on clay banks in dwarf-succulent shrublands of the Cedarberg and Richtersveld, and in the Karoo at Worcester. Map 105.

Vouchers: *Magill & Schelpe* 3850; *Oliver et al.* PRE-CH12887; *Schelpe* 7622; *Van Zanten et al.* 7608306d.

Specimens may be confused macroscopically with *Goniomitrium*, but the narrow, papillose leaves and persistent epigonium distinguish this species.

FIG. 80.—**Bryobartramia novae-valesiae: 1.** habit, ×1; **2.** habit, ×5; **3.** stem in cross section, ×180; **4–5.** leaves, ×40; **6.** leaf in cross section, ×350; **7.** cells at leaf base (right side), ×170; **8.** upper laminal cells, ×350; **9.** leaf apex, dorsal surface (papillae partly shown), ×170; **10.** axillary hair, ×200; **11.** perichaetial leaf, ×40; **12.** epigonium enclosing capsule, ×20; **13.** spore, ×640. (1–13, *Schelpe* 7672).

GRIMMIACEAE

Plants small to large, forming dense turfs or cushions, blackish green to yellow-green; mostly saxicolous. *Stems* erect; central strand present or absent. *Leaves* ovate to lanceolate; apex acute to acuminate, often with hyaline tips or awns; lamina frequently bistratose or only margins thickened. *Costa* percurrent to excurrent; in section cells frequently undifferentiated. *Laminal cells* quadrate to rectangular, incrassate, smooth, lateral walls frequently sinuate to nodose; basal cells elongate, walls sinuate to straight.

Perichaetia terminal. *Seta* short, erect or cygneous; capsule immersed or exserted, ovoid to cylindrical; peristome single, teeth 16, cleft or perforated, reddish; operculum rostrate; calyptra mitriform; spores small.

1 Lateral walls of basal cells sinuate to nodose; stems without central strand...3. **Racomitrium**
1 Lateral walls of basal cells smooth to weakly sinuolate; stems with central strand:
2 Plants small, blackish; perichaetia conspicuous, hyaline, perichaetial leaves strongly differentiated; capsule immersed, annulus persistent.....1. **Leucoperichaetium**
2 Plants small to medium, dark green to yellow-green; perichaetia not distinct; capsules exserted or immersed, annulus deciduous.....2. **Grimmia**

1. LEUCOPERICHAETIUM

Leucoperichaetium *Magill,* gen. nov., *ad* Grimmiam *accedens sed ab eo cellulis laminae parietibus plerumque rectis, foliis perichaetii distinctissimis et annulo persistenti super ostium thecae ubi sicco inflexo differt.*

Plantae parvae pro parte maxima infossae, tapetiformes, nigrae ad atrovirides; saxicolae vel terricolae. Rami *in parte superiore ramificantes; filo medio.* Folia *parva, mutica; lamina bistratosa supra basim.* Costa *percurrens, grege substereidarum dorsalium.* Celluli laminae *quadrati, parietibus plerumque rectis.*

Perichaetia terminalia conspicua; foliis distinctissimis, piliferis, hyalinis. Seta *brevissima; theca immersa cupulata; peristomio rudimentali papilloso; annulo persistanti, erecto ubi humido inflexo super ostium ubi sicco; operculo convexo-apiculato; calyptra parva mitriformi.*

Type species: *L. eremophilum* Magill.

Plants small, mostly buried, forming turfs, blackish to blackish green; saxicolous or terricolous. *Stems* branching above; central strand present. *Leaves* small, muticous; lamina bistratose above base. *Costa* percurrent, with dorsal substereid band. *Laminal cells* quadrate, walls mostly straight.

Perichaetia terminal, conspicuous; leaves strongly differentiated, piliferous, hyaline. *Seta* very short; capsule immersed, cupulate; peristome rudimentary, papillose; annulus persistent, erect wet, inflexed over mouth dry; operculum convex-apiculate; calyptra small, mitriform.

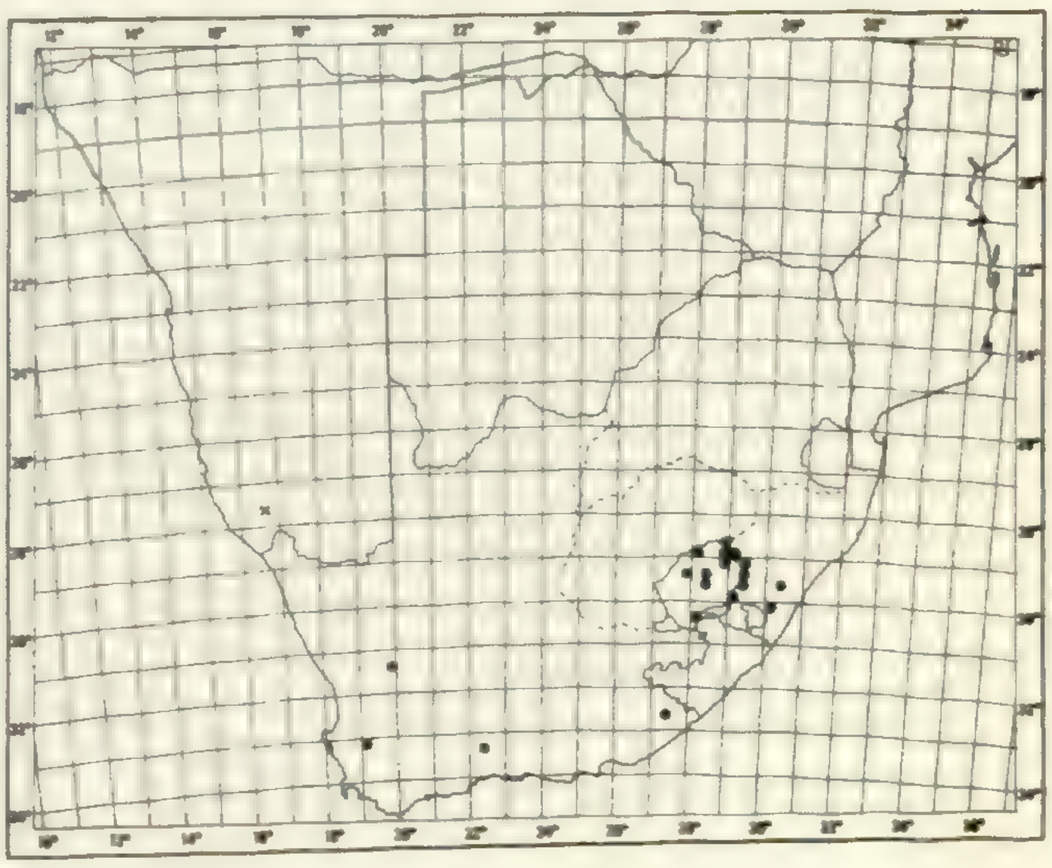
Similar to *Grimmia* but differing in mostly straight-walled laminal cells, strongly differentiated perichaetial leaves and persistent annulus that inflexes over capsule mouth when dry.

Leucoperichaetium eremophilum *Magill*, sp. nov., *bene distincta dignoscenda plantis parvis pro parte maxima infossis, nigribus; perichaetiis magnis hyalinis; foliis vegetativis oblongo-acuminatis*, 0,8–1,2 *mm longis, muticis, bistratosis supra basim; foliis perichaetiorum late ovalibus, abrupte piliferis, hyalinis; theca immersa, peristomio rudimentali; annulo persistenti, alto cellulis quattuor, hygroscopico.*

Type: South West Africa/Namibia, Witpütz, on quartzite outcrop, *Hardy* 4864 (PRE, holo.; H; MO; NY; US).

Plants small, in irregular turfs, blackish green; saxicolous. *Stems* erect, 5–10 mm long, mostly buried, frequently branching; in section round, central strand large, inner cortical cells in 3–4 rows, thin-walled, outer row slightly smaller, weakly thickened. *Leaves* weakly appressed to incurved dry, patent wet, crowded above; oblong-acuminate, 0,8–1,2 mm long, gradually larger above on fertile plants, subperichaetial leaves to 1,5 mm long; apex acute; margins erect, entire; lamina in distal section bistratose, in proximal section unistratose or with small bistratose areas. *Costa* percurrent to just excurrent as weak hyaline tip; in proximal section oval, guide cells 4, slightly thickened, ventral cells in single row, similar to laminal cells, dorsal substereid band weak, 1–2 cells thick, dorsal surface cells similar to laminal cells, outer walls strongly thickened, in distal section oval, guide cells 2, dorsal substereid band present, reduced to 4–6 cells, dorsal and ventral surface cells similar to laminal cells, incrassate. *Upper laminal cells* rounded-quadrate, incrassate, smooth; basal cells larger, quadrate to rectangular, thin-walled.

Cladautoicous. Perigonia terminal; leaves broadly ovate-acuminate, 0,6–0,7 mm long; perichaetia terminal, strongly differentiated, conspicuous; leaves gradually modified toward apex, outer perichaetial leaves dark green with hyaline bases; obovate, abruptly acuminate; margins entire; upper laminal cells rounded quadrate, incrassate; basal cells larger, rectangular, thin-walled, extending up margins to above mid-leaf; inner perichaetial leaves light green to hyaline throughout; broadly oval, abruptly piliferous; margins irregularly serrate at apex; costa short-excurrent; upper laminal cells rhombic, incrassate; basal cells larger, rectangular, very thin-walled, occupying lower $\frac{2}{3}$ of leaf. *Seta* erect, 0,3 mm long; capsule immersed, urn cupulate, 0,7 mm long, mouth wide; exothecial cells rectangular to oblong-hexagonal, thin-walled, stomata large, restricted to base of capsule; annulus persistent, cells subhexagonal, very strongly thickened, to 4 cells high, inflexed and narrowing mouth when dry, upright when wet; peristome rudimentary, teeth irregular, just visible above annulus, ornately papillose;



MAP 106.— ● **Grimmia ovalis**
× **Leucoperichaetium eremophilum**

FIG. 81.—**Leucoperichaetium eremophilum** (1–18): **1.** habit, ×1; **2.** habit (soil level shown), ×5; **3.** vegetative leaves, ×40; **4.** upper leaves from fertile branch, ×40; **5.** subperichaetial leaf, ×40; **6.** perichaetial leaf, ×40; **7.** leaf in proximal cross section, ×240; **8.** leaf in lower median cross section, ×240; **9.** leaf in upper median cross section, ×240; **10.** leaf in distal cross section, ×240; **11.** cells at leaf base (left side), ×170; **12.** cells at perichaetial leaf base (right side), ×170; **13.** apex of vegetative leaf, ×170; **14.** apex of upper leaf from fertile branch, ×170; **15.** apex of subperichaetial leaf, ×170; **16.** apex of perichaetial leaf, ×170; **17.** capsule and perichaetial leaf, ×15; **18.** part of capsule mouth with persistent annulus and peristome teeth, ×310. **Grimmia apocarpa** (19–29): **19.** habit, wet, ×1; **20.** habit, dry, ×1; **21.** habit, ×5; **22.** muticous leaves, ×20; **23.** piliferous leaf, ×20; **24.** leaf in cross section, ×130; **25.** cells at leaf base (right side), ×130; **26.** upper laminal cells at right margin, ×130; **27.** leaf apex, ×130; **28.** part of capsule mouth with peristome teeth, ×240; **29.** capsule with perichaetial leaves, ×10. (1–8, *Hardy* 4864; 19–22 & 24–29, *Magill* 4197; 23, *Liebenberg* 5848).

operculum low-convex, bluntly apiculate; calyptra mitrate, smooth, covering upper capsule; spores subround, 12–15 μm, granulate. Fig. 81: 1–18.

Endemic to Southern Africa, *L. eremophilum* is presently known only from quartzite outcrops in the dwarf succulent shrublands of southern South West Africa/Namibia. Map 106.

Voucher: *Hardy* 4869.

The small, blackish green plants with large, conspicuous, hyaline perichaetia distinguish this species from other Southern African taxa. The species is also unique within Grimmiaceae because of the stark contrast between the small, bistratose, muticose vegetative leaves and the large, hyaline, piliferous perichaetial leaves. In addition, the immersed, cupulate capsules with rudimentary peristomes and persistent annulus, which inflexes and thus narrows the capsule mouth when dry, will help to identify the species.

2. GRIMMIA

Grimmia *Hedw.*, Spec. Musc. 75 (1801); Broth. in Natürl. PflFam. 10: 306 (1924); Sim, Bryo. S. Afr. 206 (1926). Lectotype species: *G. plagiopodia* Hedw., vide B.S.G., Bryol. Eur. 3: 99 (1845).

Plants small to medium, in dense tufts or cushions; saxicolous or terricolous. *Stems* irregularly branched; central strand present. *Leaves* frequently with hyaline point or awn. *Laminal cells* small above, at mid-leaf short-rectangular, sinuate; basal cells elongate, mostly straight-walled.

Seta straight or curved; capsule immersed or exserted, smooth or 8-ribbed; peristome teeth generally cleft above.

A widespread genus of 242 species, *Grimmia* is found throughout temperate and subtropical regions. The genus is found in Southern Africa in association with rock substrates.

1 Capsules immersed; leaves generally muticous or apex hyaline ..... 1. *G. apocarpa*
1 Capsules exserted; leaves with hyaline awn, short or long (sometimes absent):
  2 Leaf lamina unistratose, margins thickened; capsule ribbed, seta frequently curved ..... 2. *G. pulvinata*
  2 Leaf lamina bistratose:
    3 Leaves lanceolate to ovate-acuminate; basal leaf cells short-rectangular ..... 3. *G. ovalis*
    3 Leaves oval to ovate-lanceolate; lower juxtacostal cells frequently linear, basal cells quadrate ..... 4. *G. laevigata*

1. **Grimmia apocarpa** *Hedw.*, Spec. Musc. 76 (1801); Broth. in Natürl. Pflfam. 10: 311 (1924); Sim, Bryo. S. Afr. 206 (1926). Type: Germany, *Dillenius* s.n.

Grimmia depilis C. Müll., Syn. Musc. 1: 778 (1849); Broth. in Natürl. PflFam. 10: 311 (1924). Type: Cape, Philipstown, *Pappe* s.n.

Grimmia caffra C. Müll. in Hedwigia 38: 118 (1899); Broth. in Natürl. PflFam. 10: 311 (1924). Type: Orange Free State, Witteberg, Kadziberg, *Rehmann* 130 (PRE!).

Grimmia boschbergiana C. Müll. in Hedwigia 38: 119 (1899); Broth. in Natürl. PflFam. 10: 311 (1924). Type: Cape, Somerset East, Boschberg, *MacOwan* 1877 (GRA!).

Grimmia oranica C. Müll. in Hedwigia 38: 119 (1899); Broth. in Natürl. PflFam. 10: 311 (1924). Syntypes: Orange Free State, Bethlehem, *Rehmann* 131 (PRE!); Kadziberg, *Rehmann* 132 (PRE!).

Plants medium-sized, forming tufts, dark green, blackish below, occasionally reddish or brownish, saxicolous. *Stems* erect to inclined, 10–30 mm long, branched; in section central strand small, inner cortical cells in 4–5 rows, lax, outer cortical cells in single row, stereids or substereids, yellowish. *Leaves* spreading wet, little altered to erect dry; ovate-acuminate, 1,5–2,5 mm long, frequently bistratose above; apex acute to broadly acute, sometimes hyaline, infrequently with long, hyaline, toothed awn; margins plane, entire, frequently bistratose, occasionally multistratose above. *Costa* percurrent or extending into awn; in section cells large, undifferentiated, incrassate. *Upper laminal cells* quadrate to short-rectangular, incrassate, frequently sinuate; basal cells

short-rectangular to rectangular, occasionally quadrate, walls smooth to sinuolate.

Autoicous. Perichaetia terminal, leaves slightly larger, sheathing capsule. *Seta* short, 0,5 mm long, erect; capsule immersed, urn ovoid, to 1,5 mm long, smooth; peristome teeth triangular, perforated above, reddish yellow; operculum rostrate; spores round, 12–15 μm, essentially smooth. Fig 81: 19–29.

Almost cosmopolitan; in Southern Africa *G. apocarpa* is frequently collected on rock, in grasslands of the Drakensberg of Lesotho, eastern Orange Free State and Natal. The species is also collected in the eastern Transvaal, Natal and the eastern, central and southwestern Cape. Map 105.

Vouchers: *Cholnoky* 98; *Crosby & Crosby* 7944; *Hilliard & Burtt* 10612; *Killick* 4204; *Magill* 3369, 4680; *Schelpe* 7548; *Schmitz* 6971a.

This widespread species is variable and many of its forms are present in Southern Africa. Plants collected in the Karoo are generally small and little branched with narrow, awned leaves, while plants growing in stream-beds of the Drakensberg are larger with broad leaves and generally lack awns or hyaline apices. The species is easily distinguished from other members of the family through its immersed capsules, that are almost always present.

2. **Grimmia pulvinata** (*Hedw.*) *J. E. Sm.*, Engl. Bot. 24: 1728 (1807); Broth. in Natürl. PflFam. 10: 310 (1924); Sim, Bryo. S. Afr. 209 (1926). Type: Europe.

Fissidens pulvinatus Hedw., Spec. Musc. 158 (1801).

Fissidens pulvinatus var. *africanus* Hedw., Spec. Musc. 159 (1801). *Grimmia pulvinata* var. *africana* (Hedw.) Hook. f. & Wils. in Hook. f., Fl. Nov. Zel. 2: 75 (1854). Type: Cape, *Swartz* s.n.

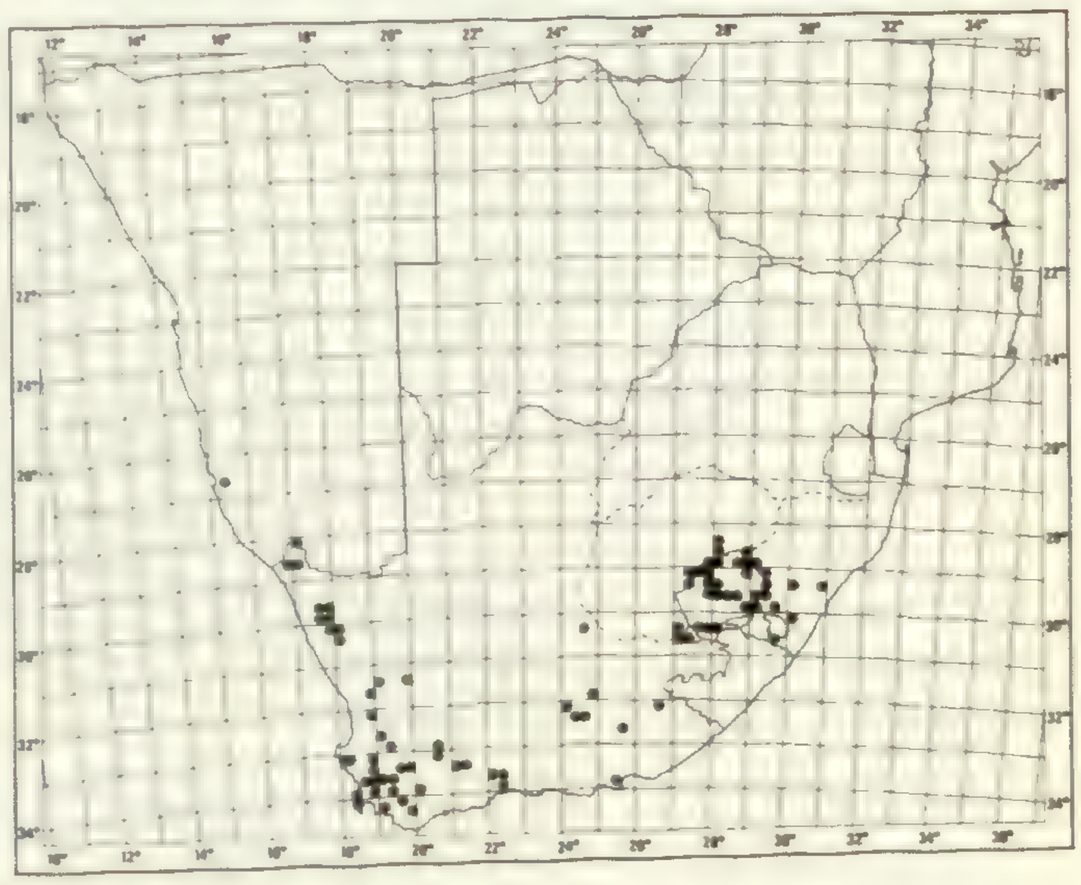
Grimmia leptotricha C. Müll. in Hedwigia 38: 120 (1899); Broth. in Natürl. PflFam. 10: 310 (1924). Type: Cape, Somerset East, Boschberg, *MacOwan* s.n. (BM!).

Grimmia drakensbergensis Sim, Bryo. S. Afr. 209 (1926). Type: Natal, *Symons* sub *Sim* 9962 (PRE!).

Plants small, forming dense cushions, blackish to yellow-green; saxicolous or terricolous. *Stems* erect, 5–15 mm high, branched below; in section central strand small, inner cortical cells in 3–5 rows, large, yellowish, outer cortical cells in 1–2 rows, substereids, yellowish. *Leaves* appressed, weakly spiralled dry, erect-spreading wet; lanceolate to ovate-acuminate, 3,0–3,5 mm long; apex acute to obtuse; margins plane, entire, bistratose to multistratose above base. *Costa* excurrent as a generally smooth, hyaline awn, to 1 mm long, rarely percurrent; in section guide cells 2, large, ventral cells absent, dorsal stereid band 3–4 cells thick, dorsal surface cells large, incrassate. *Upper laminal cells* short-rectangular, sinuate; basal cells long-rectangular to linear, walls smooth or rarely sinuolate.

Autoicous. Perichaetia terminal; leaves undifferentiated. *Seta* frequently curved, 2–3 mm long, yellowish; capsule exserted, inclined to pendulous, urn ovoid, 1 mm long, 8-ribbed dry; peristome teeth triangular, 2–3-cleft above, perforated below, weakly papillose, red-yellow; operculum short-rostrate; spores round, 12–13 μm, smooth. Fig. 82: 1–13.

Grimmia pulvinata is distributed worldwide. In the Flora area it is most frequently collected in grasslands of the Drakensberg of Natal and Lesotho and in the Western Cape. Specimens have also been collected in southern South West Africa/Namibia, Natal, Orange Free State and the eastern, southern and central Cape. Map 107.



MAP 107.— ● **Grimmia pulvinata**

Vouchers: *Brenan* M2738; *Cholnoky* 969; *Dieterlen* 815; *Edwards* 659; *Magill* 4275, 4651; *Schelpe* 7682; *Schmitz* 7870; *Stokoe* PRE-CH12774; *Van der Westhuizen & Deetlefs* 26.

The leaf shape of *G. pulvinata* is variable and sterile forms occasionally resemble *G. apocarpa* on one extreme and *G. ovalis* on the other. An upper mid-leaf section, however will reveal marginal thickenings and only rarely, isolated areas of bistratose lamina. The strongly ribbed, inclining or pendulous capsule is also quite distinctive. In addition, the plants are generally a lighter colour than other South African species of *Grimmia* and have a greasy or oily appearance when dry, making the leaves appear translucent. Var. *africana* is occasionally separated (cf. Smith, 1978) on the basis of ovoid capsules and short-conical opercula.

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3. **Grimmia ovalis** (*Hedw.*) *Lindb.* in Act. Soc. Sci. fenn. 10: 75 (1871); Gangulee, Moss. E. India, 1: 797 (1972); Grout, Moss Fl. N. Amer. 2: 33 (1933). Type: Europe, Saxony, *Hedwig* s.n., 1792 (G).

Dicranum ovale Hedw., Spec. Musc. 140 (1801).

Grimmia commutata Hueb., Musc. Germ. 185 (1833), nom. illeg.; Sim, Bryo. S. Afr. 210 (1926); vide Sayre in Bryologist 54: 183 (1951).

Plants small to medium, olive-green to blackish green, in dense cushions; saxicolous. *Stems* erect, 5–20 mm tall, branching; in section round, central strand small, inner cortical cells in 3–5 rows, large, outer cortical cells smaller, incrassate, yellowish. *Leaves* appressed dry, spreading wet; ovate-acuminate, 2–3 mm long; lamina bistratose above; apex acute, generally with short, smooth, hyaline awn; margins entire, frequently one side weakly recurved. *Costa* percurrent to short-excurrent; in section guide cells 2, exposed ventrally, dorsal stereid or substereid band 1–2 cells thick, dorsal surface cells large, incrassate. *Upper laminal cells* quadrate, walls smooth; basal cells rectangular, walls sinuolate.

Dioicous. Perichaetia terminal, leaves oblong-acuminate, to 4 mm long. *Seta* straight, 2,0–2,5 mm long; capsule exserted, urn ovoid to short-oblong, 1,0–1,5 mm long, smooth; peristome teeth perforated or 2–3-cleft above, weakly papillose, reddish yellow; operculum short-rostrate, beak ± oblique; spores round, 9–12 μm, essentially smooth. Fig. 82: 14–19.

A very widespread species; in Southern Africa *G. ovalis* is concentrated in grasslands of the Drakensberg of Lesotho, Orange Free State and Natal. A few specimens have also been collected in southern Natal and the eastern, southern and western Cape. Map 106.

Vouchers: *Edwards* PRE-CH5437; *Killick* 4218; *Magill* 4688; *Schelpe* 2116.

Where they overlap in the Drakensberg, this species and *G. pulvinata* are superficially very similar. Fertile specimens of *G. ovalis* are easily distinguished by the smooth, erect capsules. Sterile specimens are generally distinguished by their narrower leaves and bistratose upper lamina.

4. **Grimmia laevigata** (*Brid.*) *Brid.*, Bryol. Univ. 1: 183 (1826); Gangulee, Moss. E. India 1: 800 (1972); Scott & Stone, Moss. S. Aust. 99 (1976). Type: Europe.

Campylopus laevigatus Burch., Mant. Musc. 76 (1819).

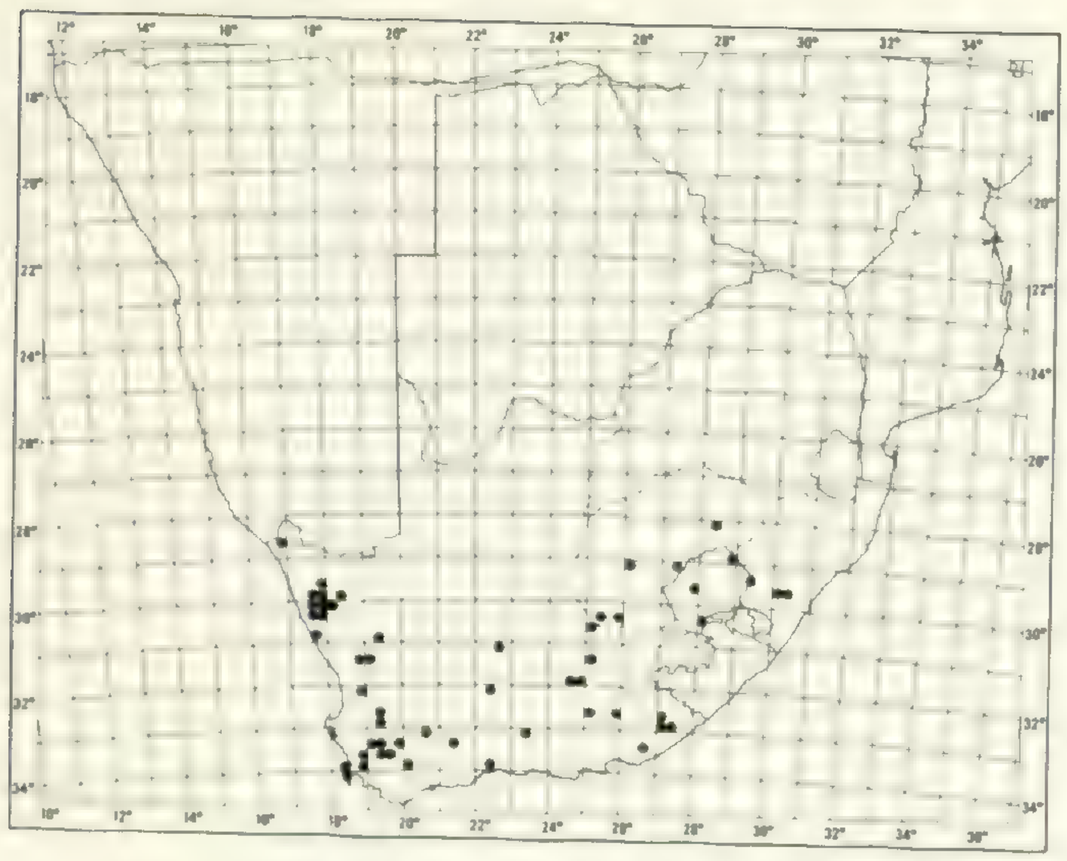
Grimmia campestris Burch. ex Hook., Musci Exot. 2: 129 (1819); Sim, Bryo. S. Afr. 208 (1926). Type: Cape, Roggeveld, *Burchell* s.n.

Grimmia senilis Sim, Bryo. S. Afr. 207 (1926). Type: Cape, *Sim* 9956 (PRE!).

Plants medium-sized, in loose tufts, dark grey-green, hoary, or rarely yellow-green; saxicolous or terricolous. *Stems* erect, to 20 mm tall, branching below; in section central strand small, inner cortical cells in 4–5 rows, large, outer cortical cells in 2 rows, smaller, incrassate. *Leaves* appressed dry, spreading wet; concave, lamina bistratose above; ovate to broadly ovate, 3–4 mm long; apex broadly acute, frequently hyaline, extended into a long, spinose, hyaline awn, to 2 mm long, hyaline apical cells frequently decurrent down margins of upper leaf; margins plane, entire or serrate at apex. *Costa* broad below, quickly narrowing, weak above mid-leaf but extending to apex; in distal section guide cells 2, exposed ventrally, dorsal stereid or substereid band small, 2–3 cells thick, dorsal surface cells larger, incrassate. *Upper laminal cells* quadrate to transversely short-rectangular, somewhat longer at basal angles; lower juxtacostal cells elongate, merging with costa, rarely undifferentiated.

Dioicous. Perichaetia terminal; leaves sheathing, oblong-aristate, to 4 mm long. *Seta* short, straight, 1,0–1,5 mm long, yellowish; capsule emergent, urn elliptical, 1,0–1,5 mm long, smooth, light brown; peristome teeth cleft above, smooth, reddish yellow; operculum short-rostrate; spores round, 12–14 μm, smooth. Fig. 82: 20–26.

FIG. 82.—**Grimmia pulvinata** (1–13): **1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, dry, ×5; **4.** habit, wet, ×5; **5.** leaves, ×10; **6.** leaf in cross section, ×435; **7.** basal leaf cells at right margin, ×150; **8.** cells at upper leaf base (right side), ×150; **9.** upper laminal cells at left margin, ×150; **10.** upper laminal cells at right margin (strongly incrassate form), ×150; **11.** leaf apex, ×150; **12.** part of capsule mouth with peristome teeth and spores, ×270; **13.** capsule and calyptra, ×5. **G. ovalis** (14–19): **14.** habit, wet, ×1; **15.** habit, dry, ×1; **16.** habit, ×5; **17.** leaves, ×25; **18.** leaf in cross section, ×220; **19.** upper laminal cells, ×290. **G. laevigata** (20–26): **20.** habit, wet, ×1; **21.** habit, dry, ×1; **22.** habit, ×5; **23–24.** leaves, ×25; **25.** leaf in cross section, ×220; **26.** cells at leaf base (left side), ×130. (1–13, *van Zanten et al.* 76091054; 14–19, *Killick* 4207; 20–26, *Magill* 4692).



MAP 108.— ● **Grimmia laevigata**

Grimmia laevigata has a worldwide distribution. In Southern Africa, the species is frequently found on rock or shallow soil in drier areas of the Cape, Orange Free State, Lesotho and Natal. Map 108.

Vouchers: *Esterhuysen* 18785; *Hilliard & Burtt* 10664; *Hardy* 4313; *Jacot Guillarmod* 6122a; *Lavranos* 17001; *Magill* 4692; *Retief* PRE-CH12698; *Schelpe* 7815.

The leaf shape, broad costal base, and spinose awn distinguish *G. laevigata* from other members of the genus.

Insufficiently Known Species

Grimmia assurgens Shaw in Cape Monthly Mag. 17: 380 (1878). Type: Cape, Katberg, *Shaw* s.n., 1869. The type has probably been destroyed. The species is described as having "leaves papillose" which lead Sim (1926) to suggest that it is related to *Tortula*.

3. RACOMITRIUM

Racomitrium *Brid.*, Mant. Musc. 78 (1819); Broth. in Natürl. PflFam. 10: 312 (1924); Sim, Bryo. S. Afr. 210 (1926). Lectotype species: *R. canescens* (Hedw.) Brid., vide Pfeiffer, Nom. 2: 907 (1874).

Plants medium to large, dark green to yellow-green, in large, loose cushions; saxicolous. *Stems* erect, with numerous short branches; central strand absent. *Leaves* lanceolate, frequently with hyaline tip or awn. *Laminal cells* rectangular, sinuate or nodose.

Capsule exserted, erect, ovoid-cylindric, smooth; peristome 2–3-cleft above; operculum rostrate; calyptra mitriform.

A very widespread genus of 79 species scattered on every continent, including Antarctica. In Southern Africa *Racomitrium* is uncommon on rock in the southern and southwestern Cape Province and in isolated localities in the Drakensberg of Natal and Lesotho.

1 Leaves with a long, hyaline awn; apical hyaline margin decurrent down leaf, toothed and papillose; plants yellowish ..... 1. *R. lanuginosum*

1 Leaves with short, hyaline awn or awn absent; leaf margins entire; plants dark green:

2 Alar cells differentiated, enlarged, quadrate, smooth-walled; lower marginal cell walls sinuate .... 2. *R. nigroviride*

2 Alar cells not differentiated; lower marginal cells smooth-walled, occasionally in several rows .... 3. *R. crispulum*

1. **Racomitrium lanuginosum** (*Hedw.*) *Brid.*, Mant. Musc. 79 (1819); Scott & Stone Moss. S. Austr. 106 (1976). Type: Europe.

Trichostomum lanuginosum Hedw., Spec. Musc. 109 (1801).

Racomitrium hypnoides Lindb. in Öfvers. K. VetenskAkad. Förh. 23: 552 (1866), nom. illeg.; Sim, Bryo. S. Afr. 212 (1926).

Racomitrium lanuginosum var. *pruinosum* Wils. in Hook. f., Fl. Nov. Zel. 2: 76 (1854). *Racomitrium rpuinosum* (Wils.) C. Müll. in Verh. zool.-bot. Ges. Wien 19: 224 (1869). Type: New Zealand, North Island, *Colenso* s.n.

Racomitrium incanum C. Müll. in Verh. zool.-bot. Ges. Wien 19: 224 (1869). Syntypes: Cape, Table Mountain, *Ecklon* s.n.; *Thunberg* s.n.

Plants large, in loose mats, yellow to yellow-green, hoary; saxicolous. *Stems* erect to inclined, 40–80 mm long, with numerous short branches throughout; in section round, central strand absent, inner cortical cells in 6 rows, medium-sized, smaller toward margin, outer cortical cells in 1–2 rows stereids, reddish. *Leaves* appressed with contorted acumens dry, spreading wet; lanceolate to

oblong-lanceolate, 3,0–3,5 mm long; apex acuminate, hyaline, toothed and papillose, hyaline region decurrent down margins; base undifferentiated; margins plane to recurved, toothed above, crenulate below. *Costa* strong, ending in apex; in section reniform, guide cells 6, large, strongly thickened, exposed ventrally, dorsal cells smaller, substereids. *Laminal cells* rectangular, strongly incrassate, nodose-sinuate; basal cells larger, rectangular; basal marginal cells smooth-walled, in single row, to 20 cells high.

Sporophyte not known from Southern Africa. Fig. 83: 10–18.

This widespread species is generally locally abundant in coastal mountain regions. In Southern Africa, *R. lanuginosum* is found on rock or shallow soils in the fynbos biome of the southern and south-western Cape, especially on Table Mountain. Map 109.

Vouchers: *Esterhuysen* 15773; *Pillans* 4087; *Sim* 9287.

The large, hoary, yellow patches formed by this moss are unmistakable. In addition the long-serrate, hyaline hair-points are unique and denote the Southern Hemisphere variety *R. lanuginosum* var. *pruinosum* Hook. f. & Wils.

2. **Racomitrium nigroviride** (*C. Müll.*) *Par.*, Ind. Bryol. Suppl. 294 (1900); Broth. in Natürl. PflFam. 10: 313 (1924); Sim, Bryo. S. Afr. 211 (1926). Type: Cape, Table Mountain, *Rehmann* 139 (PRE!).

Grimmia nigroviridis C. Müll. in Hedwigia 38: 121 (1899).

Grimmia nigroviride var. *robusticulum* C. Müll. in Hedwigia 38: 121 (1899). *Racomitrium nigroviride* var. *robusticulum* (C. Müll.) Par., Ind. Bryol. Suppl. 294 (1900). Type: Cape, Devil's Peak, *Rehmann* 139c (NH!).

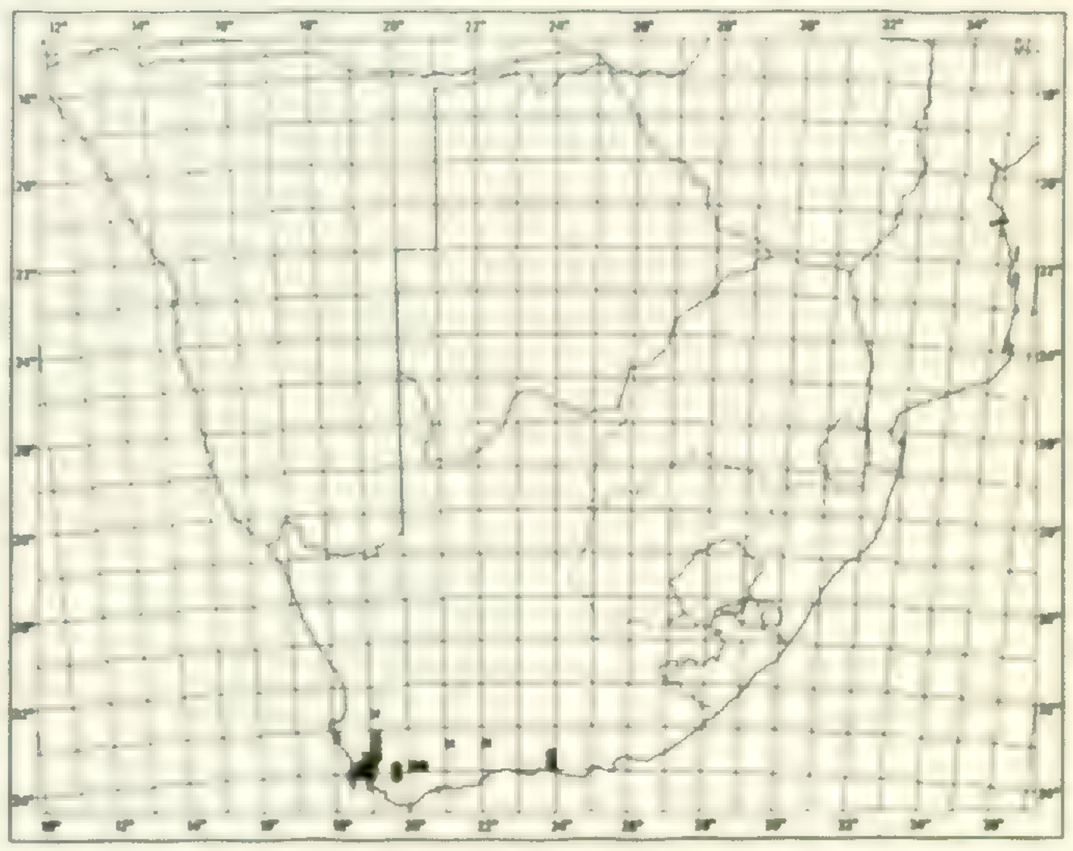
Grimmia pseudoacicularis C. Müll. in Hedwigia 38: 120 (1899). *Racomitrium pseudoacicularis* (C. Müll.) Par., Ind. Bryol. Suppl. 157 (1900). Type: Cape, *Drège* s.n. (H-BR!).

Racomitrium defoliatum Dix. in Smithson. misc. Collns 69(2): 16 (1918), vide De Sloover in Bull. Jard. nat. bot. Belg. 47: 167 (1977). Type: Kenya, western slope Mt Kenya, *Mearns* 1593 (BM; US).

Plants medium-sized, in tufts, blackish to olive-green; saxicolous. *Stems* erect, 10–40 mm high; in section round, central strand absent, inner cortical cells small, in 8–10 rows, thin-walled, becoming smaller toward margin, thickened, yellowish, outer cortical cells in 2–4 rows, small, stereids to sub-stereids, red-yellow. *Leaves* erect dry, recurved wet, weakly secund, lamina bistratose becoming multistratose toward margins; ovate-acuminate, 3,5–4,5 mm long; apex acute, without hair-point, occasionally with short hyaline tip; base auriculate; margins incurved below, entire, without basal border of smooth-walled cells. *Costa* strong, broad, ending in apex; in section reniform, cells in 4–5 rows, large, incrassate, undifferentiated. *Laminal cells* short-rectangular, incrassate, nodose; alar cells forming distinct auriculate group, enlarged, thin-walled, smooth-walled, occasionally red-brown.

?Dioicous. Perigonia not seen. Perichaetia terminal; leaves not differentiated. *Seta* to 4 mm long, dark red; capsule elliptical, 2 mm long; peristome teeth 2–3-cleft to below middle, vertically striate below, ornately papillose above, yellowish orange; operculum rostrate, to 1 mm long; spores round, 12–13 μm, granulate. Fig. 83: 1–9.

Known from afro-alpine regions of eastern Africa and the fynbos biome of Southern Africa, *R. nigroviride* is infrequently collected on the mountains of the southwestern and southern Cape. Map 109.



MAP 109.— ● **Racomitrium lanuginosum**
× **Racomitrium nigroviride**

Vouchers: *Crosby & Crosby* 8179; *Esterhuysen* 18573, 21358; *Primos* PRE-CH9697; *Thorne* PRE-CH3454.

The distinct alar group and absence of smooth-walled border cells on the lower leaf margins separate this species from *R. crispulum*. The unique leaf cells of of *Racomitrium* distinguish *R. nigroviride* from other related mosses.

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3. **Racomitrium crispulum** (*Hook. f. & Wils.*) *Hook. f. & Wils.* in Hook. f., Fl. Nov. Zel. 2: 75 (1854); Broth. in Natürl. PflFam. 10: 313 (1924); Sim, Bryo. S. Afr. 212 (1926). Type: Campbell Island, *Menzies* s.n. (BM).

Dryptodon crispulus Hook. f. & Wils. in Hooker, Lond. J. Bot. 3: 544 (1844).

Racomitrium capense Lor., Moosstud. 163 (1864); Broth. in Natürl. PflFam. 10: 313 (1924). Type: Cape, *Ecklon* s.n.

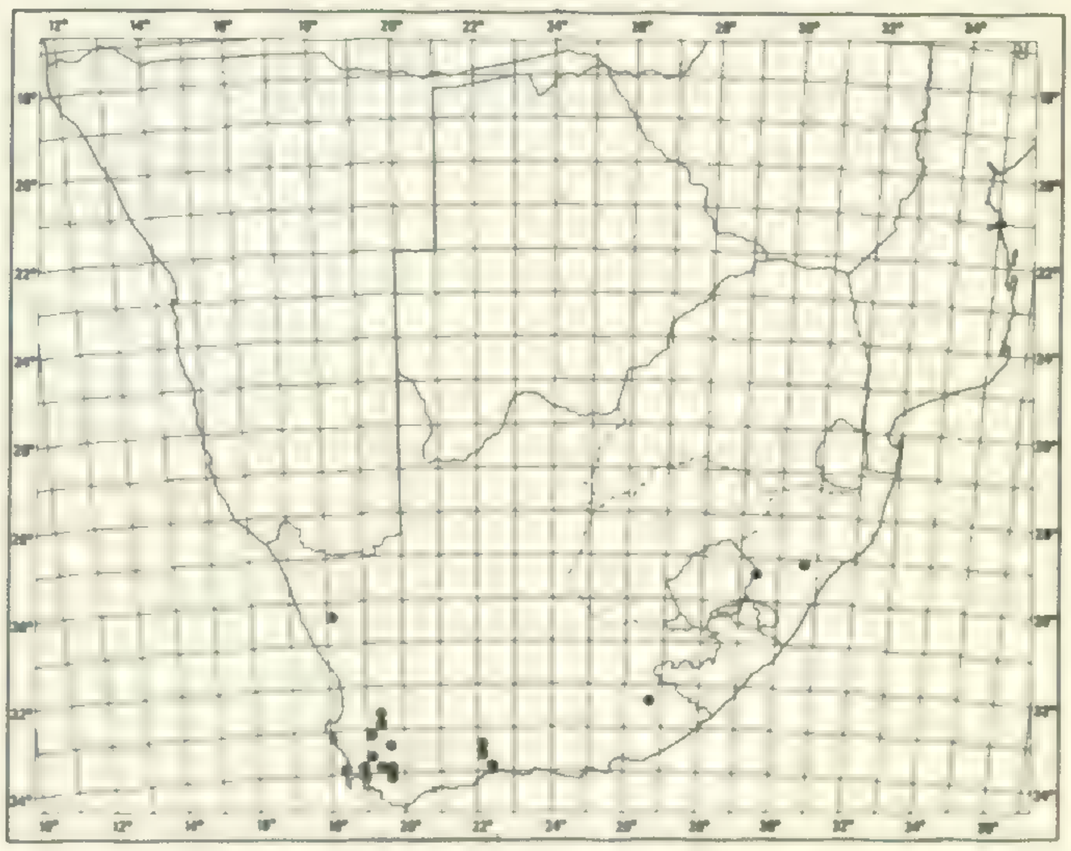
Grimmia austropatens C. Müll. in Hedwigia 38: 121 (1899), hom. illeg., non C. Müll. in Neum., Deutschl. Exp. Int. Polarforsch. 2: 316 (1890). *Racomitrium austropatens* Broth. in Natürl. PflFam. 10: 313 (1924). Type: Cape, Table Mountain, *Rehmann* 137 (NH!; PRE!).

Racomitrium drakensbergense Sim, Bryo. S. Afr. 212 (1926). Type: Natal, *Symons* sub *Sim* 8697 (PRE!).

Plants large, in dense tufts, olive-green to blackish green; saxicolous. *Stems* erect, 20–70 mm tall; in section round, central strand absent, inner cortical cells in 5–6 rows, incrassate, outer cortical cells in 1–2 rows, stereids, reddish. *Leaves* appressed dry, recurved wet; ovate-acuminate, 3–4 mm long; apex acute, rarely with short hyaline hair-point; margins weakly recurved, entire; in section lamina unistratose or bistratose region restricted to marginal ¼ of lamina. *Costa* strong, ending in acumen; in section reniform, guide cells 6–8, large, incrassate, exposed ventrally, dorsal cells smaller, incrassate. *Laminal cells* short-rectangular, strongly incrassate, nodose; alar cells not forming distinct group, reddish yellow; basal marginal cells smooth-walled, to 25 cells high, 1 (–2) cells wide.

Dioicous. Perichaetia terminal; leaves not differentiated. *Seta* 3–4 mm long, yellow-red; capsule cylindrical, 1,5 mm long; peristome teeth irregularly 2–3-cleft to lower ¼, papillose below, ornately papillose above, yellow-orange; operculum rostrate, 1 mm long; spores round, 17–18 μm, granulate. Fig. 83: 19–27.

Widespread in the Southern Hemisphere, *R. crispulum* is infrequently collected in the western, southern and eastern Cape and a few localities in Natal. Map 110.



MAP 110.— ● **Racomitrium crispulum**

Vouchers: *Brenan* M2771; *Cholnoky* 1011; *Esterhuysen* 15774, 21326, 27049; *Rourke* 1688.

The differentiated basal marginal cells, bistratose margins and generally unistratose lamina distinguish Southern African specimens of *R. crispulum*.

FIG. 83.—**Racomitrium nigroviride** (1–9): **1.** habit, wet, ×1; **2.** habit, dry, ×1; **3.** habit, ×5; **4.** leaves, ×10; **5.** leaf in cross section, ×125; **6.** cells at leaf base (left side), ×170; **7.** upper laminal cells, ×435; **8.** leaf apex, ×170; **9.** part of capsule mouth with peristome teeth, ×40. **R. lanuginosum** (10–18): **10.** habit, wet, ×1; **11.** habit, dry, ×1; **12.** habit, ×5; **13.** leaves, ×10; **14.** leaf in proximal section, ×125; **15.** leaf in distal section, ×125; **16.** basal cells at right margin, ×435; **17.** leaf apex, ×40; **18.** enlargement of awn (right margin), ×640. **R. crispulum** (19–27): **19.** habit, wet, ×1; **20.** habit, dry, ×1; **21.** leaves, ×10; **22.** leaf in cross section, ×125; **23.** cells at lower basal leaf margin, ×170; **24.** upper laminal cells, ×435; **25.** leaf apex, ×170; **26.** calyptra, ×5; **27.** capsule, ×5. (1–9, *Thorne* PRE-CH 3454; 10–18, *Boucher* 3665; 19–27, *Thorne* PRE-CH6423).

INDEX TO FASCICLE 1

ACAULON *C. Müll.* **198**, 202, 204, 206, 240
capense *C. Müll.* 201
chrysacanthum *Stone* 199
leucochaete *Stone* **199**, 201
muticum (*Hedw.*) *C. Müll.* 198, 201
recurvatum *Magill* **199**
rufochaete *Magill* **201**
sphaericum *Shaw* 201

ALOINA (*C. Müll.*) *Kindb.* **193**, 206, 240
aloides (*Schultz*) *Kindb.* 193
bifrons (*De Not.*) *Delgadillo* **193**, 194
rigida sensu Sim 193

ANDREAEA *Hedw.* **33**, 35, 36
bistratosa *Magill* **37**
nitida *Hook. f. & Wils.* **35**
petrophila Fuernr. 35
rupestris *Hedw.* 33, **35**, 36, 37
subulata *Harv. ex Hook.* **33**, 35

ANDREAEACEAE **33**

ANISOTHECIUM *Mitt.*
natalense P. Varde 121
symonsii (Dix.) Broth. 122

ANOECTANGIUM *Schwaegr.* **179**
assimilis Broth. & Wag. 181
compactum *Schwaegr.* 179
wilmsianum (*C. Müll.*) *Par.* **181**, 186

ANOMOBRYUM *Schimp.* 120

AONGSTROEMIA *B.S.G.* **118**
section *Dicranella* C. Müll. 120
abruptifolia C. Müll. 121
borgeniana Hampe 121
filiformis (*P. Beauv.*) *Wijk & Marg.* **118**, 120
gymnomitrioides Dix. 110
julacea (*Hook.*) *Mitt.* **120**
longipes (*Somm.*) *B.S.G.* 118
minuta Hampe 124
subsubulata Hampe ex C. Müll. 121
transvaaliensis C. Müll. 118
vulcanica (Brid.) C. Müll. 118

ARCHIDIACEAE **71**
Archidiella Irmsch.
dinteri Irmsch. **72**

ARCHIDIUM *Brid.* **71**, 75, 81
subgenus Archidiella (*Irmsch.*) *Snider* 72
subgenus Archidium 72
acanthophyllum *Snider* **75**
africanum Mitt. **74**
amplexicaule *C. Müll.* **80**, 81
andersonianum *Snider* **81**
campylopodium C. Müll. 78
capense *Hornsch.* **78**, 81
chrysosporum Schimp. ex Jaeg. 80
compactum fo. *tenerior* C. Müll. 78
dinteri (*Irmsch.*) *Snider* **72**
ecklonii Hampe ex C. Müll. **86**
julicaule *C. Müll.* **80**
laterale *Bruch ex Krauss* 81
leptophyllum P. Varde 74
microthecium *Dix. & P. Varde* **74**, 75
muelleranum *Snider* **77**, 81
ohioense *Schimp. ex C. Müll.* 71, **74**, 75
pellucidum Dix. ex Sim 74
phascoides *Brid.* 71
rehmannii *Mitt.* **77**, 78, 81
subulatum *C. Müll.* **77**

ASTOMUM *Hampe* 251
breutelianum Hampe ex C. Müll. 84
nervosum (Hook.) C. Müll. 86
pappeanum C. Müll. 84
tetragonum (Hook.) Broth. 250

BARBULA *Hedw.* 213, 233, **236**, 237, 239, 240, 246
section *Asteriscium* C. Müll. 230
acutata *C. Müll.* 213, **239**
afrocaespitosa C. Müll. 256
afrofontana (*C. Müll.*) *Broth.* **246**
afroinermis C. Müll. **213**
afroruralis C. Müll. 219
anoectangiacea *C. Müll.* 246
australasiae (Hook. & Grev.) Brid. 232
brachyaichme C. Müll. 215
brevimucronata C. Müll. 216
caespitosa Schwaegr. 256
calycina *Schwaegr.* **240**, 241, 243
chrysoblasta C. Müll. 213
circinalis C. Müll. 210
crinita *Schultz* **237**, 239
deserta C. Müll. 210
dimorpha C. Müll. 233
dregeana C. Müll. 193
erubescens C. Müll. 215
erythroneura C. Müll. 219
eubryum *C. Müll.* **245**, 246
eutrichostoma C. Müll. 256
exesa C. Müll. 215
flexicaulis *C. Müll.* **246**
flexuosa (Hook.) Schultz **240**

hildebrandtii C. Müll. 215
hookeri Steud. 241
hornschuchiana *Schultz* **240**
humilis Hedw. 256
indica (*Hook.*) *Spreng.* **243**, 245
jamesonii Tayl. 248
leptotortella C. Müll. 259
leucostega C. Müll. 219
longipedunculata C. Müll. 210
macowaniana C. Müll. 215
microcalycina *Magill* **241**, 243
muelleri B.S.G. 219
natalensicaespitosa C. Müll. 256
natalensis C. Müll. 243
oranica C. Müll. 215
orientalis (Web.) Broth. 243
pagorum Milde 217
parvula (Hook. & Grev.) Spreng. 209
perlinearis *C. Müll.* 246
pertorquata *C. Müll.* 246
pilifera (Hook.) Brid. 237
porphyreoneura C. Müll. ex Vent. 213
recurvata (Hook.) Schultz 209
rehmannii *C. Müll.* **245**
reticularia C. Müll. 218
ruralis Hedw. 219
schmidii C. Müll. 215
torquatifolia Geh. 213
torquescens Schimp. ex C. Müll. 237
trichostomacea C. Müll. 232
trivialis C. Müll. 232
unguiculata *Hedw.* 236
xanthocarpa C. Müll. **235**, 246

BARTRAMIA *Hedw.* 122

BLINDIA *B.S.G.* **103**
acuta (*Hedw.*) *B.S.G.* 103
magellanica *Schimp. ex C. Müll.* **103**, 104

BRUCHIA *Schwaegr.* **106**, 108, 111
brevipes *Harv. ex Hook.* **108**
eckloniana *C. Müll.* **110**
elegans (Hornsch.) C. Müll. 108
foveolata *Magill* **108**, 110
rehmannii C. Müll. 84
vogesiaca *Schwaegr.* 106

BRUCHIACEAE 106

BRYOBARTRAMIA *Sainsb.* **269**
novae-valesiae (*Broth.*) *Stone & Scott* .. **269**, 270
robbinsii Sainsb. **269**

BRYOBARTRAMIACEAE **269**

BRYOERYTHROPHYLLUM *Chen* **246**, 248
afrorubellum (Broth. & Wag.) De Sloover ... 248
jamesonii (*Tayl.*) *Crum* **248**, 249
recurvirostrum (*Hedw.*) *Chen* 264, **248**, 249

CALYMPERACEAE 156, **161**
subfamily OCTOBLEPHAROIDEAE 161

CALYMPERES *Sw.* **163**, 164
levyanum *Besch.* **166**
lonchophophyllum *Schwaegr.* 163
nashii Williams 164
rabenhorstii *Hampe & C. Müll.* **164**
tenerum *C. Müll.* var. edamense *Fleisch.* **164**, 166
victoriae *Dix.* 166

CAMPYLOPUS *Brid.* **138**, 139, 143, 154
section *Microcampylopus* C. Müll. 137
altovirescens (C. Müll.) Par. 146
ampliretis (*C. Müll.*) *Par.* **140**, 142
angustinervis Dix. 138
atroluteus (*C. Müll.*) *Par.* ... 147, **148**, 150, 154
aureoviridis (*C. Müll.*) *Schimp. ex Par.* 154
bartramiaceus (C. Müll.) Thér. ex Broth. 148, 150
basalticolus (C. Müll.) Par. 146
bequaertii *Thér. & Nav.* **143**, 144, 147
bewsii Sim 152
bicolor (*C. Müll.*) *Wils.* 150
var. ericeticola (*C. Müll.*) *Dix.* 150
bryhnii Broth. 146
capensis Broth. 142
catarractilis (C. Müll.) Par. 148
chlorotrichus (C. Müll.) Par. 142
delagoae (*C. Müll.*) *Par.* **140**, 142
echinatus Sim 150
edwardsii Sim 140
flexuosus (*Hedw.*) *Brid.* 138
griseolus (C. Müll.) Par. 152
heteroneurum Thér. 140
imerangae orth. var. 146
inandae (C. Müll.) Par. 142
inchangae (*C. Müll.*) *Par.* 143, **146**, 147, 150
introflexus (*Hedw.*) *Brid.* 138, **150**, 151, 152, 153
laevigatus Brid. 277
lepidophyllus (C. Müll.) Jaeg. 150
leptotrichaceus (C. Müll.) Par. 148
leucobasis (C. Müll.) Par. 150
longescens (C. Müll.) Par. 146
nanotenax (C. Müll.) Par. 146
nanus C. Müll. 121
olivaceonigricans (C. Müll.) Par. 140
pallidus *Hook. f. & Wils.* **147**, 150
perfalcatus Broth. 142
perpusillus Mitt. 138
pilifer *Brid.* **152**, 153

polytrichoides De Not. 152
procerus (*C. Müll.*) *Par.* **153**, 154
pseudobicolor *C. Müll. ex Ren. & Card.* 150
pseudojulaceus Sim 144
pulvinatus (C. Müll.) Par. 147
purpurascens Lor. 152
purpureoaureus (C. Müll.) Par. 152
serridorsus (C. Müll.) Par. 146
simii *Schelpe* **144**
stenopelma (*C. Müll.*) *Par.* **142**, 143, 147
stramineus (*Mitt.*) *Jaeg.* 143
subchlorophyllosus *C. Müll. ex Rabenh.* **144**, 146
symonsii Sim 152, 153
tenax (C. Müll.) Broth. 142
trichodes Lor. 152
var. *perlamellosus* Dix. 152
weisiopsis (C. Müll.) Par. 150

CERATODON *Brid.* **94**, 246
purpureus (*Hedw.*) *Brid.* **94**, 96
stenocarpus Bruch & Schimp. ex C. Müll. .. 94

CHORISODONTIUM (*Mitt.*) *Broth.* **154**
aciphyllum (*Hook. f. & Wils.*) *Broth.* 155
dicranellatum (*Dus.*) *Roiv.* 155
falcatum *Magill* **154**

CLADOPHASCUM *Dix.* **110**, 111
gymnomitrioides (*Dix.*) *Dix. ex Sim* **110**

Conomitrium Mont. 39
capensis C. Müll. 68
erosulum C. Müll. 58
gracile Hampe ex C. Müll. 51
julianum (Cand.) Mont. 67
pseudoserratum C. Müll. 61
scleromitrius Besch. 55

CROSSIDIUM *Jur.* **195**, 197, 198, 206, 240
apiculatum *Magill* **195**, 197
spiralifolium *Magill* **197**
squamiferum (*Viv.*) *Jur.* 195

CYNODONTIUM *Schimp.*
capillaceum Hedw. 98

DESMATODON *Brid.* **209**, 210
convolutus (*Brid.*) *Grout* **209**, 210, 212
latifolius (*Hedw.*) *Brid.* 209
longipedunculatus (*C. Müll.*) *Magill* **210**, 212
recurvatus (Hook.) Mitt. 209

Diaphanophyllum Lindb.
vallis-gratiae Lindb. 93

DICRANACEAE 69, 89, **105**, 156, 161
subfamily DICRANELLOIDEAE **118**
subfamily DICRANOIDEAE **126**
subfamily LEUCOBRYOIDEAE **156**, 161
subfamily TREMATODONTOIDEAE **106**, 111

DICRANELLA (*C. Müll.*) *Schimp.* .. 69, 70, 89, **120**, 121, 122, 126
abruptifolia (C. Müll.) Par. **121**
borgeniana (Hampe) Jaeg. **121**
minuta (Hampe) Jaeg. **124**
nana *Wint.* **121**
rigida *Dix. ex Sim* **122**, 124
subsubulata (*C. Müll.*) *Jaeg.* **121**
symonsii *Dix.* 121, **122**

DICRANODONTIUM *B.S.G.*
chlorotrichus (C. Müll.) Par. 142
laxitextum Broth. & Bryhn 146
perfalcatum (C. Müll.) Par. 142

DICRANOLOMA (*Ren.*) *Ren.* **130**, 133
billardieri (*Brid.*) *Par.* 130, **132**, 133
entabeniense *Magill* **132**
nitidulum (*C. Müll.*) *Par.* 133

DICRANUM *Hedw.*
section *Chorisodontium* Mitt. 154
altovirescens C. Müll. 146
ampliretis C. Müll. 140, 148
atroluteus C. Müll. 148
aureoviridis C. Müll. 154
bartramiaceus C. Müll. 148
basalticolus C. Müll. 146
billardieri Brid. 132
catarractilis C. Müll. 148
chlorotrichus C. Müll. 142
chrysobasilare C. Müll. 133
delagoae C. Müll. 140
filiforme P. Beauv. 118
griseolus C. Müll. 152
inandae C. Müll. 142
inerangae C. Müll. 146
introflexum Hedw. 150
lepidophyllus C. Müll. 150
leptotrichaceus C. Müll. 148
leucobasis C. Müll. 150
longescens C. Müll. 146
nanotenax C. Müll. 146
nanum (C. Müll.) C. Müll. 121
nitidulum C. Müll. 133
olivaceonigricans C. Müll. 140
ovale Hedw. 277
perfalcatum C. Müll. 142
procerus C. Müll. 153
pulvinatus C. Müll. 147
purpureoaureus C. Müll. 152
purpureus Hedw. 94

rehmannii C. Müll. 136
serridorsus C. Müll. 146
sprengelianum C. Müll. 134
stenopelma C. Müll. 142
tenax C. Müll. 142
weisiopsis C. Müll. 150
zeyheri C. Müll. 134

DIDYMODON *Hedw.* **232, 233**
afer (C. Müll.) Broth. 233
afrorubellus Broth. & Wag. ex Dix. 248
capensis Spreng. 210
ceratodonteus (*C. Müll.*) *Dix.* **233,** 235
dimorphum (C. Müll.) Broth. 233
fragilis Hook. & Wils. 258
knysnae Rehm. ex Sim 235
lingulatum (Sim) Magill 184
perrevolutus P. Varde 235
pottsii Dix. 233
rigidulus *Hedw.* 233
squarrosus Hook. 189
xanthocarpus (*C. Müll.*) *Magill* **235,** 236, 246

DISTICHIUM *B.S.G.* **98**
capillaceum (*Hedw.*) *B.S.G.* **98**

DITRICHACEAE **83,** 89

DITRICHUM *Hampe* **89,** 93
amoenum (*Thwait. & Mitt.*) *Par.* 89, 93
brachypodum (*C. Müll.*) *Broth.* **92,** 93
brevifolium (C. Müll.) Broth. 92
capense (*C. Müll.*) *O. Kuntze* 93
cylindricarpum (*C. Müll.*) *F. Müll.* 90
difficile (*Dub.*) *Fleisch.* **93**
flexifolium Hampe 93
glaucescens (Hedw.) Hampe 96
homomallum (*Hedw.*) *Hampe* 89
hymenodontium Dix. 89, 92, 93
punctulatum *Mitt.* 90, **92**
spirale Dix. 89, 92
strictum (*Hook. f. & Wils.*) *Hampe* **90**
vallis-gratiae (*Lindb.*) *Hampe* 93

Dryptodon Brid.
crispulus Hook. f. & Wils. 281

ECCREMIDIUM *Hook. f. & Wils.* **88**
exiguum (*Hook. f. & Wils.*) *Wils.* 88, **89**

ENCALYPTA *Hedw.* **173**
ciliata *Hedw.* **173,** 174, 176
vulgaris *Hedw.* **174,** 176

ENCALYPTACEAE **173,** 269

EPHEMERUM *Hampe* **201**

EUCLADIUM *B.S.G.* 186
verticillatum (*Brid.*) *B.S.G.* 186

FISSIDENS *Hedw.* **39,** 63, 69, 70, 108
subgenus Aneuron *Kindb.* **41,** 44
subgenus Fissidens **43,** 44
subgenus Octodiceras (*Brid.*) *Broth.* **67**
subgenus Pachyfissidens (*C. Müll.*) *Kindb.* ... **67**
section Aloma *C. Müll.* **62**
section Areofissidens *C. Müll.* **43,** 44, 58
section Crenularia *C. Müll.* **61,** 62
section Crispidum *C. Müll.* **62,** 63
section Fissidens **46,** 47
section *Pachyfissidens* C. Müll. 67
section Semilimbidium *C. Müll.* **54,** 58
section Serridium *C. Müll.* **63**
aciphyllus *Dix.* **53,** 54
amblyophyllus C. Müll. 65
androgynus Bruch ex Krauss 46
aristatus Sim 50
arnellii P. Varde 44
asplenioides *Hedw.* 63, **65**
bifrons Schimp. ex C. Müll. 45, 57, 58
bocarangensis *P. Varde* 46
borgenii *Hampe* **58,** 59, 61
var. *obtusifolius* Dix. 59
breutelii Schimp. ex C. Müll. 48, 50
brevisetus Sim 55
bryoides *Hedw.* 39, **46,** 47
calochlorus Dix. 55
capensis (C. Müll.) Broth. 68
capriviensis *Magill* **45**
curvatus *Hornsch.* **51,** 53, 68
cuspidatus C. Müll. 51
cymatophyllus C. Müll. 62
enervis *Sim* **41**
erosulus (*C. Müll.*) *Par.* **58,** 59
eschowensis Broth. & Bryhn 54
fasciculatus *Hornsch.* 65, **67**
flaccidus *Mitt.* 46
fontanus (*B. Pyl.*) *Steud.* **67,** 68
glaucescens *Hornsch.* **62,** 63, 65, 67
gracilis (Hampe) Jaeg. 51
gueinzii C. Müll. 46
haakonii Broth. & Bryhn 58
hoeegii *P. Varde* **47**
hyalobasis Dix. ex Sim 55
ischyrobryoides C. Müll. 50
julianus (Cand.) Schimp. 67
lanceolatus Hampe 62
laxifolius Hornsch. 51
linearicaulis Broth. & Bryhn 58
longulus *C. Müll.* 68
macleanus *Shaw* 68
macowanianus C. Müll. 48
malacobryoides C. Müll. 46
marginatus *Schimp. ex C. Müll.* **50**

megalotis Schimp. ex C. Müll. 47
microandrogynus *Dix.* **55**, 57
minutiretis Dix. 48
mucronatus Schimp. ex C. Müll. 62
nitens *Rehm. ex Salm.* **62**
opacifolius Mitt. 54
papillifolius Dix. 54
parvilimbatus *Sim* **57**
pauperrimus C. Müll. 68
pectinidens Dix. 57
perpaucifolius Dix. ex Sim 57
plumosus *Hornsch.* **63**, 65, 67
procerior Broth. & Bryhn 62
pulvinatus Hedw. 275
var. *africanus* Hedw. 275
pseudoserratus (*C. Müll.*) *Jaeg.* **61**, 62
pycnophyllus C. Müll. 51, 68
pygmaeus *Hornsch.* 45, **57**, 58, 68
rehmannii C. Müll. 62
remotifolius C. Müll. 46
rufescens *Hornsch.* **47**, 48, 50
rutenbergii *Par.* 68
scleromitrius (*Besch.*) *Broth.* **55**
simii *Schelpe* **50**
splachnifolius *Hornsch.* **44**, 45, 58
stellenboschianus *Dix. ex Sim* **51**, 53
submarginatus *Bruch ex Krauss* **54**
subobtusatus *C. Müll.* 58, **59**, 61
subremotifolius C. Müll. 46
urceolatus Wag. & Dix. 54
usambaricus *Broth.* **43**
vittatus *Hook. f. & Wils.* 48
wageri *Dix. ex Wag.* **44**
zuluensis Broth. & Bryhn 62

FISSIDENTACEAE **39**

FONTINALIS *Hedw.*
antipyretica *Hedw.* 68
juliana (Savi) Savi ex Cand. 67

GONIOMITRIUM *Hook. & Wils.* 270

GRIMMIA *Hedw.* 271, **274**, 275
apocarpa *Hedw.* 35, 246, **274**, 275
assurgens *Shaw* 278
atrovirens J. E. Sm. 209
austropatens C. Müll. 281
boschbergiana C. Müll 274
caffra C. Müll. 274
campestris Burch. ex Hook. 277
commutata Hueb. 277
depilis C. Müll. 274
drakensbergensis Sim 275
laevigatus (*Brid.*) *Brid.* **277**, 278
leptotricha C. Müll. 275
nigroviridis C. Müll. 279
var. *robusticulum* C. Müll. 279
oranica C. Müll. 274
ovalis (*Hedw.*) *Lindb.* 275, **277**
plagiopodia *Hedw.* 274
pseudoacicularis C. Müll. 279
pulvinata (*Hedw.*) *J. E. Sm.* **275**, 277
var. *africana* (Hedw.) Hook. f. & Wils. ... 275
senilis Sim 277

GRIMMIACEAE **271**, 274

GYMNOSTOMUM *Nees & Hornsch.* ... 182, **183**, 184
aeruginosum *J. E. Sm.* **183**, 184
bewsii *Dix.* 183, **184**, 186
calcareum Nees & Hornsch. 183
dimorphum (C. Müll.) Sim 233
gracile (Wag. & Dix.) Dix. 233
gracile (*R. Br.*) *Hook.* 235
involutum Hook. 228
julaceum Hook. 120
lingulatum *Rehm. ex Sim* 183, **184**
pottsii (Dix.) Sim 233
recurvirostre Hedw. 182
wageri Schelpe 235

GYROWEISIA *Schimp.*
amplexicaulis Sim 221
latifolia Dix. 221

HOLOMITRIUM *Brid.* **129**
affine Card. & Thér. 129
cylindraceum (*P. Beauv.*) *Wijk & Marg.* var. cucullatum (*Besch.*) *Wijk & Marg.* **129**, 130
perichaetiale (*Hook.*) *Brid.* 129
vaginatum (Hook.) Brid. var. *cucullatum* (Besch.) C. Müll. 129

HUSNOTIELLA *Card.* **221**
latifolia (*Dix.*) *Zander & Magill* ... **221**, 222, 224
obtusifolia (*Broth.*) *Zander* 222
plicata *Magill* **222**
revoluta *Card.* 221

Hydrogonium (C. Müll.) Jaeg. 236, 237
afrofontanum (C. Müll.) Hilp. 246
ehrenbergii (Lor.) Jaeg. 236

Hymenostomum R. Br. 251, 262
brachycarpum (C. Müll.) Par. 263
cucullatum (C. Müll.) Kindb. 266
eurybasis Dix. 267
humicola (C. Müll.) Par. 266
latiusculum (C. Müll.) Par. 267
microstomum (Hedw.) R. Br. 262
opacum Wag. & Dix. 243

HYMENOSTYLIUM *Brid.* **182**
ceratodonteum (C. Müll.) Broth. 233
crassinervium *Broth. & Dix.* 183
recurvirostrum (*Hedw.*) *Dix.* **182**, 183
xanthocarpum (*Hook.*) *Brid.* 182

HYOPHILA *Brid.* 225, **228**
afrophaea (C. Müll.) Warnst. 260
atrovirens (C. Müll.) Broth. 228
baginsensis *C. Müll.* **230**
basutensis Sim 235
cyathiforme (Dix.) Sim 170
involuta (*Hook.*) *Jaeg.* **228**, 230
javanicum (*Nees & Blum.*) *Brid.* 228
plicata Mitt. 224
zeyheri (Hampe) Jaeg. 260

HYPODONTIUM *C. Müll.* **170**
dregei (*Hornsch.*) *C. Müll.* **170**, 172
pomiforme (*Hook.*) *C. Müll.* **172**
var. *macowanianum* C. Müll. 172

LEPTODONTIUM (*C. Müll.*) *Hampe ex Lindb.* 187, **189**
brachyphyllum *Broth. & Thér.* **191**, 192
longicaule *Mitt.* **191**, 192
var. microruncinatum (*Dus.*) *Zander* 191
squarrosum (Hook.) Hampe ex Lindb. 198
viticulosoides (*P. Beauv.*) *Wijk & Marg.* **189**

Leptotrichum Hampe ex C. Müll.
brachypodum C. Müll. 92
brevifolium C. Müll. 92
capense C. Müll. 93

LEUCOBRYACEAE 156, 161

LEUCOBRYUM *Hampe* **156**
acutifolium (*Mitt.*) *Card.* **156**, 158
glaucum (*Hedw.*) *Schimp.* 156
gracilifolium Dix. 158
gueinzii C. Müll. 156
isleanum *Besch.* 158
madagassum *Besch.* **158**, 159
parvulum *Card.* 158
perfalcatum Sim 158
rehmannii *C. Müll.* **158**

LEUCOLOMA *Brid.* **133**
albocinctum *Ren. & Card.* 137
bifidum (*Brid.*) *Brid.* 133
chrysobasilare (*C. Müll.*) *Jaeg.* **133**, 134
haakonii Broth. & Bryhn 136
rehmannii (*C. Müll.*) *Par.* 134, **136**, 137
sprengelianum (*C. Müll.*) *Jaeg.* **134**, 136, 137
syrrhopodontioides *Broth.* **136**
zeyheri (C. Müll.) Kindb. 134, 136, 137
zuluense Broth. & Bryhn 133

LEUCOPERICHAETIUM *Magill* **271**
eremophilum *Magill* 271, **273**, 274

LEUCOPHANACEAE 161

Lophiodon Hook. f. & Wils.
strictus Hook. f. & Wils. 90

MICROCAMPYLOPUS (*C. Müll.*) *Fleisch.* **137**, 138
nanus (C. Müll.) Broth. 121, 138
perpusillus (*Mitt.*) *Broth.* **138**
pusillus C. Müll. 121
subnanus (*C. Müll.*) *Fleisch.* 137

MICRODUS *Schimp. ex Besch.* **124**
minutus (*Hampe*) *Besch.* **124**

Moenkemeyera C. Müll. 39
mirabilis C. Müll. 39
scleromitria (Besch.) P. Varde 55

NANOBRYACEAE **69**

NANOBRYUM *Dix.* **69**, 70
dummeri *Dix.* **69**, 70
gladiolum (*Mitt.*) *Bizot* 70

NECKERA *Hedw.*
viticulosoides P. Beauv. 189

OCTOBLEPHARUM *Hedw.* 156, **161**
albidum *Hedw.* 161, **163**

Octodiceras Brid. 39, 67
capensis (C. Müll.) Jaeg. 68
fissidentoides Brid. 39
fontanum (B. Pyl.) Lindb. 67
julianum (Cand.) Brid. 67

OREOWEISIA (*B.S.G.*) *De Not.* **127**
bruntonii (*Sm.*) *Mild.* 127
erosa (*C. Müll.*) *Kindb.* **127**, 129
serrulata (Funck) De Not. 127, 129
torquescens (*Brid.*) *Wijk & Marg.* 129

OXYSTEGUS (*Limpr.*) *Hilp.* **259**
cylindricus (*Brid.*) *Hilp.* **259**, 260

PHASCONICA *C. Müll.* **251**, 253
balansae *C. Müll.* 251
lorentzii *C. Müll.* 251
tisserantii *P. Varde* **251**, 253

PHASCUM *Hedw.* 198, **202**, 204, 206
cuspidatum *Hedw.* 202
elegans Hornsch. 108
exiguum Hook. f. & Wils. 88
leptophyllum *C. Müll.* **202**, **204**

nervosum Hook. 86
peraristatum *C. Müll.* **202**, 204
splachnoides Hornsch. 208
tetragonum Hook. 250

PLEURIDIUM *Rabenh.* **83**, 86, 108
breutelianum (Hampe) Jaeg. 84
ecklonii (*C. Müll.*) *Snider* **86**
nervosum (*Hook.*) *Mitt.* **86**, 88
papillosum *Magill* **88**, 89
pappeanum (*C. Müll.*) *Jaeg.* **84**, 86, 88
subulatum (*Hedw.*) *Rabenh.* 83

POLYTRICHACEAE 198

POTTIA (*Reichenb.*) *Fuernr.* **204**, 206, 209, 210
afrophaea C. Müll. 260
ceratodontea C. Müll. 233
drummondii (*Wils.*) *Willis* 209
macowaniana *C. Müll.* **207**, 208
maritima (*R. Br. ter.*) *Broth.* 209
namaquensis *Magill* **206**, 207
splachnoides (*Hornsch.*) *Broth.* 207, **208**, 209
subplanomarginata *Dix.* **207**, 208
truncata (*Hedw.*) *B.S.G.* 204
verrucosa Rehm. ex Warnst. 207, 208
zeyheri Hampe ex C. Müll. 260

POTTIACEAE 127, **177**, 236, 269
subfamily POTTIOIDEAE **178**
subfamily TRICHOSTOMOIDEAE **249**
tribe BARBULEAE **227**
tribe LEPTODONTIEAE **186**
tribe PLEUROWEISIEAE **179**
tribe POTTIEAE **192**

PSEUDOCROSSIDIUM *Williams* 213, 239, 240

PTERYGONEURUM *Jur.* **197**, 240
cavifolium *Jur.* 197
macleanum *Warnst.* **197**, 198

RACOMITRIUM *Brid.* **278**, 279
austropatens Broth. 281
canescens (*Hedw.*) *Brid.* 278
capense Lor. 281
crispulum (*Hook.f. & Wils.*) *Hook.f. & Wils.* 279, **281**
defoliatum Dix. 279
drakensbergense Sim 281
hypnoides Lindb. 278
lanuginosum (*Hedw.*) *Brid.* **278**, 279
var. *pruinosum* Wils. 278, 279
incanum C. Müll. 278
nigroviride (*C. Müll.*) *Par.* **279**
var. *robusticulum* (C. Müll.) Par. 279
pruinosum (Wils.) C. Müll. 278
pseudoacicularis (C. Müll.) Par. 279

SAELANIA *Lindb.* **96**
caesia (*P. Beauv.*) *Lindb.* **96**
glaucescens (*Hedw.*) *Broth.* **96**

SCHISTIDIUM Brid. 246

SCHISTOMITRIUM *Dozy & Molk.*
acutifolium Mitt. 156

SELIGERIACEAE **103**

Semibarbula Herz. ex Hilp. 236, 237
indica (Hook.) Herz. ex Hilp. 236, 243
orientalis (Web.) Wijk & Marg. 243

Skitophyllum B. Pyl. 39
fontanum B. Pyl. 67

Sphaerangium Schimp.
capense (C. Müll.) Jaeg. 201

SPHAGNACEAE **23**

SPHAGNUM *L.* **23**
africanum *Welw. & Dub.* **28**, 29
austromolle C. Müll. 31
balfourianum Warnst. 27
beyrichianum Warnst. 32
capense *Hornsch.* **31**, 32
var. *austromolle* (C. Müll.) Warnst. 31
var. *mollissimum* (C. Müll.) Warnst. 31
var. *multiporosum* Warnst. 32
convolutum Warnst. 29
coronatum C. Müll. 29
var. *cuspidatum* Warnst. 29
fimbriatum *Wils. in Hook.* **24**, 26
fluctuans C. Müll. 29
laceratum sensu Garside 26
marlothii Warnst. 27
marginatum Warnst. 29
var. *convolutum* Warnst. 29
var. *diversifolium* Warnst. 29
mollissimum C. Müll. 31
obtusiusculum *Warnst.* **26**
oligodon C. Müll. 28
var. *bachmannii* Warnst. 28
var. *beyrichii* Warnst. 28
oxycladum Warnst. 29
palustre *L.* 23
panduraefolium C. Müll. 29
pappeanum C. Müll. 26
perichaetiale *Hampe* **27**
pycnocladulum *C. Müll.* **29**, 31, 32
var. *fuscescens* Warnst. 29
var. *viride* Warnst. 29
rehmannii Warnst. 28
strictum *Sull.* subsp. pappeanum (*C. Müll.*) *Eddy* **26**, 27

transvaaliense Warnst. 28
truncatum *Hornsch.* **29**

Sporledera Hampe
rehmannii (C. Müll.) Kindb. 84

SYRRHOPODON *Schwaegr.* **166**
dregei Hornsch. 170
erectifolius C. Müll. 167
gardneri (*Hook.*) *Schwaegr.* 166
gomesii *P. Varde* **167**
obliquirostris *C. Müll.* **169**
perichaetialis Bruch ex Krauss 170
pomiformis (Hook.) Hampe ex C. Müll. 172
uncinifolius *C. Müll.* **167**, 169

TETRAPTERUM *Hampe ex Jaeg.* **250**, 251
australe *Hampe* 250
tetragonum (*Hook.*) *Andrews* **250**, 251

Thysanomitrion Schwaegr. 138
delagoae (C. Müll.) Broth. 140
inandae (C. Müll.) Broth. 142
richardii (Brid.) Schwaegr. 138
transvaaliense Herz. & Dix. ex Sim 140

TIMMIELLA (*De Not.*) *Limpr.* **253**, 254
anomala (*B.S.G.*) *Limpr.* 253
cameruniae *Broth.* 254
pelindaba *Magill* **253**

TORTELLA (*Lindb.*) *Limpr.* **255**, 259
afrocaespitosa (C. Müll.) Broth. 256
caespitosa (Schwaegr.) Limpr. 255, 256
calycina (Schwaegr.) Dix. 240
eutrichostomum (C. Müll.) Broth. 256
fragilis (*Hook. & Wils.*) *Limpr.* 255, **258**, 259
humilis (*Hedw.*) *Jenn.* 255, **256**, 258
natalensicaespitosa (C. Müll.) Broth. 256
petrieana Sim 256
rufiseta (C. Müll.) Broth. 255, 256
tortuloides (Sull. & Lesq.) Broth. 255, 256
xanthocarpa (*C. Müll.*) *Broth.* **255**, 256, 262

TORTULA *Hedw.* **212**, 213, 215, 218, 239, 240, 246, 278
afroruralis (C. Müll.) Broth. 219
ammonsiana *Crum & Anderson* **216**, 218
atrovirens (J.E. Sm.) Lindb. 209
australasiae Hook. & Grev. 232
bifrons De Not. 193
brachyaichme (C. Müll.) Broth. 215
brevimucronata (C. Müll.) Broth. 216
brevitubulosa Broth. 216
deserta (C. Müll.) Broth. 210
erubescens (C. Müll.) Broth. 215
erythroneura (C. Müll.) Broth. 219
eubryum (C. Müll.) Broth. 245
exesa (C. Müll.) Broth. 215
flexuosa Hook. 240
hildebrandtii (C. Müll.) Broth. 215
indica Hook. 243
irregularis Sim 216
leucostega (C. Müll.) Broth. 219
longipedunculata (C. Müll.) Broth. 210
macowaniana (C. Müll.) Broth. 215
muelleri Hook. f. & Wils. 219
muralis *Hedw.* **213**, 215
oranica (C. Müll.) Broth. 215
pagorum (*Mild.*) *De Not.* 216, **217**, 218
papillosa *Wils. ex Spruce* **218**
parvula Hook. & Grev. 209
pilifera Hook. 237
var. *longifolia* Sim 237
porphyreoneura (*C. Müll.*) *Townsend* ... **213**, 239
princeps *De Not.* **218**, 219
recurvata Hook. 209
reticularia (C. Müll.) Broth. 218
ruralis (*Hedw.*) *Gaertn., Meyer & Scherb.* **219**, 221
schmidii (*C. Müll.*) *Broth.* **215**, 216
subtorquatifolia Dix. 210
subulata *Hedw.* 212
torquatifolia (Geh.) Dix. 213
trachyneura Dix. 219, 221

TRACHYCARPIDIUM *Broth.*
novae-valesiae Broth. ex Roth 269

TREMATODON *Michx.* **111**, 117
subgenus Gymnotrematodon *C. Müll. ex Broth.* 111
subgenus Trematodon 111
aequicollis Ren. & Card. 115
africanus Wag. & Dix. 115, 117
divaricatus *Bruch ex Krauss* **114**, 115
flexifolius C. Müll. 115
intermedius *Welw. & Duby* **112**, 114
ligulatus Rehm. ex Roth 117
longicollis *Michx.* 111, **115**, 117
mayottensis *Besch.* **117**
pallidens C. Müll. 115
paradoxus *Hornsch.* **114**, 115
pillansii *Dix. ex Sim* **112**

TRICHOSTOMOPSIS *Card.* **230**, 232, 233
australasiae (*Hook. & Grev.*) *Robinson* .. **232**, 233
crispifolia *Card.* 230
trivialis (*C. Müll.*) *Robinson* **232**

TRICHOSTOMUM *Bruch* 251, **260**
section *Hydrogonium* C. Müll. 236
afrofontanum C. Müll. 246
afrum C. Müll. 233

atrovirens Rehm. ex C. Müll. 228
brachydontium *Bruch ex F. A. Muell.* 253, **260**, 262
convolutum Brid. 209
cyathiforme Dix. 170
cylindricum (Brid.) C. Müll. 259
difficile Dub. 93
glaucescens Hedw. 96
lanuginosum Hedw. 278
leiodontium *C. Müll.* 262
orientalis Web. 243
rehmannii Sim 255, 256
rufisetum C. Müll. 255
squarrosum (Hook.) Schwaegr. 189
tortuloides Sull. & Lesq. 255, 256
xanthocarpum Schimp. ex C. Müll. 255

TRIQUETRELLA *C. Müll.* **187**
papillata (*Hook. f. & Wils.*) *Broth.* 188
strictissima Rehm. ex C. Müll. 187
tristicha (*C. Müll.*) *C. Müll.* **187**, 188

Tristichiopsis C. Müll.
mirabilis C. Müll. 99

TRISTICHIUM *C. Müll.* 99
lorentzii *C. Müll.* 99
mirabile (*C. Müll.*) *Herz.* **99**

WEISIOPSIS *Broth.* **224**, 225, 227, 230
anomala (*Broth. & Par.*) *Broth.* 224
involuta *Magill* **225**, 227
plicata (*Mitt.*) *Broth.* **224**, 225
pulchriretis *Dix.* **225**

WEISSIA *Hedw.* 251, 253, **262**, 263, 267, 268
subgenus Hymenostomum (*R. Br.*) *Kindb.* .. 262
subgenus Weissia 262
subgenus *Oreoweisia* B.S.G. 127
brachycarpa C. Müll. 263
controversa *Hedw.* 262, 263, **265**, 266
var. *pillansii* Schelpe 263
cucullata *C. Müll.* **266**, 267
cylindricus Bruch ex Brid. 259
dieterlenii *Thér.* **263**, 265, 266
erosa Hampe ex C. Müll. 127
gracilis Wag. & Dix. 233
humicola *C. Müll.* 263, 265, **266**
latiuscula *C. Müll.* **267**, 268
linguaelata Shaw 265
oranica C. Müll. 265
pomiformis Hook. 172
recurvirostris Hedw. 248
vallis-gratiae C. Müll. 265
viridula Hedw. ex Brid. 265
var. *brachycarpa* (C. Müll.) Dix. 263, 266
var. *longifolia* Broth. & Wag. 265
vulcanica Brid. 118

ZYGODON *Hook. & Tayl.*
simii Dix. 189
tristichus C. Müll. 187
wilmsianum C. Müll. 181

Vol. 12: Portulacaceae, Basellaceae, Caryophyllaceae, Illecebraceae, Cabombaceae, Nymphaeaceae, Ceratophyllaceae, Ranunculaceae, Menispermaceae, Annonaceae, Trimeniaceae, Lauraceae, Hernandiaceae, Papaveraceae, Fumariaceae

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